

Light and Lighting

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Illuminations

THERE is no denying the popular appeal of external floodlighting and of the decoration of public gardens, and other suitable places, with coloured lights. The "illuminations" at Buxton inaugurated by the Mayor on the first night of the I.E.S. Summer Meeting last month were undoubtedly welcomed, alike by townsfolk and by visitors. Of course, this kind of lighting—like any other—can be done with different degrees of merit, and the lighting engineer, the architect, and the aesthete—irrespective of his calling—will usually have some criticism to make of any example he sees. But let us keep clearly in mind the purpose of this lighting for the public. It is not to reveal things as we *ordinarily* see them: on the contrary, it is to transform the mundane (beautiful though this may be) and allow us a brief excursion into a refreshingly novel environment. In this new world, uninteresting buildings and other landscape features that besiege and distract our sight by day are temporarily "pulled down," and a simplified panorama is spread out before us in which selected features appear in an ordinarily unseen guise. In this new world we do not want to see buildings modelled as they are by Nature's high-pitched light sources, but to see them in an unfamiliar way.

Notes and News

I.E.S. Summer Meeting

The recent I.E.S. meeting at Buxton is reported in full elsewhere in this issue. Those requiring still further information on the technical papers are advised to obtain the full text of the papers and discussions which, it is understood, are to be published in one number of the "I.E.S. Transactions" in due course.

We make particular mention of the fact that the discussions are to be published, even though this is the normal procedure of the I.E.S., for, good though the papers themselves were, the discussions were of an extremely high standard and will add considerably to the value of the published proceedings of the summer meeting. We have been to many meetings and papers, both I.E.S. and others (though mainly others) where the discussions have been deadly. It is a difficult thing, of course, to organise a discussion; it can so easily become a series of lecturettes from prepared scripts. The discussions at Buxton, however, were really stimulating, even though one or two set pieces were put over. The I.E.S. is fortunate in including amongst its members one or two very good speakers, but even they sat up and took great notice during the discussion on the stage lighting paper when the remarks of three well-known stage personalities added much to the technical value of the paper and discussion, and also capped what was already a most enjoyable lecture.

Another interesting feature of the meeting was the high proportion of members of the I.E.S. Centres and Groups who were present and took part in the discussions. There is no doubt that these periodic provincial conferences serve a good purpose both for the industry and the society, and the fact that there were slightly fewer people present at Buxton than at Harrogate two years

ago is only a sign of the times through which we are now passing. If they maintain their present high standard the I.E.S. can look forward to far greater attendances when conditions are more normal.

Chemistry of the Visual Process

In his address to the Colour Group of the Physical Society on April 26, Professor R. A. Morton outlined earlier knowledge of the photochemical substances on which human vision depends, and described the latest developments in which his own researches have played a big part. He recalled that in 1921, as a research student at Liverpool University, he had formed one of a group of subjects in the late Professor Hecht's comparison of the spectral sensitivity curve of the dark-adapted eye and the spectral absorption curve of the photosensitive substance, visual purple, contained in the retina. The identity of these two curves, when certain corrections have been applied, forms the corner-stone of our theory of the photochemical phase of the visual process. The next major step was the hypothesis that for the full development of dark-adapted vision the body must be supplied with vitamin-A or with a substance such as the colouring matter of the carrot which can be converted into vitamin-A in the body. Amongst the mass of more or less cogent evidence supporting this idea, Professor Morton mentioned a convincing study made during the war on conscientious objectors who volunteered to live on a diet free from vitamin-A or precursor substances. It was only after some months when the concentration of vitamin-A in the body had fallen to a low level that dark adaptation was affected but the result was definite. It is probable, therefore, that visual purple

is formed from vitamin-A. Thanks to the work of Lythgoe, Wald and others, a considerable knowledge of the products of decomposition of visual purple by light has been accumulated. The immediate product is an unstable orange substance (transient orange) which at body temperature passes rapidly into a substance with the properties of an acid-base indicator (indicator yellow) and consisting probably of a yellow substance, retinene, in association with a protein. Thus vitamin-A and retinene form in a certain sense the end terms in the chain of visual substances, and their chemical structure has been established. The molecule of vitamin-A consists of a chain of ten carbon atoms linked by alternately single and double bonds, and terminated at one end by a carbon ring (β -ionone ring) and at the other by an alcohol group. The molecule of retinene is identical, except that the alcohol group is replaced by an aldehyde group. As first established by Professor Morton, a synthetic retinene can be prepared from vitamin-A by the use of manganese dioxide as a catalyst, and the synthetic product has closely similar properties to the retinene derived by bleaching visual purple. According to recent work by Wald the reverse change, retinene to vitamin-A, can be brought about by enzyme action in processes which are analogous to others known to occur in the body. Turning to the chemical structure of transient orange, indicator yellow and visual purple, Professor Morton described compounds he had synthesised in which retinene molecules were substituted for the hydrogen atoms attached to the nitrogen in an "amino" group (NH_2) forming part either of a simple molecule such as methylamine or of a complicated one such as a protein. Compounds produced in this way show many similarities with the visual substances mentioned, and it appears that the elucidation of the chemical structure of visual purple itself may not be very distant.

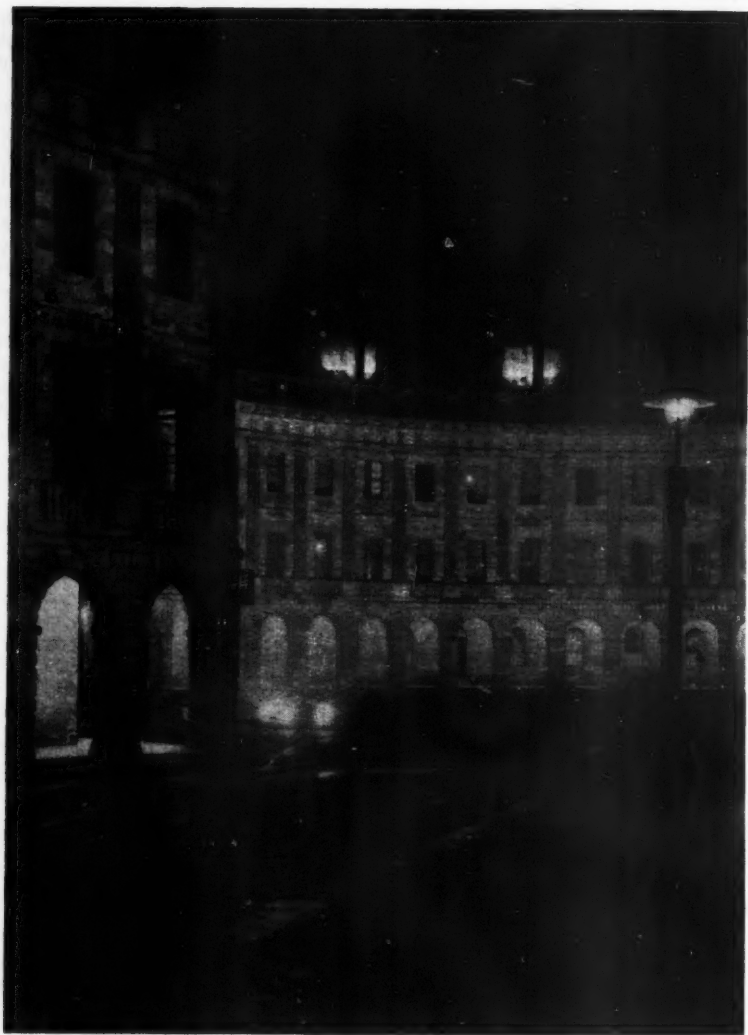
While for dark-adapted or rod vision much progress has been made, the chem-

istry of light-adapted or cone vision, on which colour discrimination depends, is still obscure. So far it has proved possible to extract from the retina only one photosensitive substance—iodopsin—of different spectral sensitivity from visual purple, and this has been found only in chicken retinas. Could visual purple be the primary substance in cone as well as rod vision? It had been shown that visual purple in strong acids gave rise to a number of photosensitive substances with narrow spectral sensitivity curves recalling those obtained by Granit in studies of the electrical response to light of animal retinæ. Professor Morton emphasised that the conditions of formation of these substances were highly "unphysiological" and could hardly occur in the retina, but the results illustrated the chemical possibilities of visual purple as a source of coloured substances of the kind that seemed to be required to explain colour vision.

Fittings Design

Examples of actual fittings and photographs of fittings already included in the 1951 Stock List are at present on show at the exhibition of Home Furnishings organised by the Council of Industrial Design in London. The exhibits, it is said, "are likely to set a new high standard and greatly influence public taste"—a statement with which quite a few people will disagree. Opinions on the lighting fittings range from the view that they are hideous, to the milder comment that they are unsuitable for use in the home. Some of the fittings are good—but there are few we would care to live with.

Designs, for furnishings, approved by the C.I.D. must, it would seem, perpetuate the utility designs of recent years; which is hardly setting a high standard, or, we think, influencing the public taste along the right lines. We hope the South Bank Exhibition is not going to be a super-utility show.



A view of the Crescent which, together with a number of other buildings in Buxton, was floodlighted during the course of the I.E.S. Summer Meeting there.

I.E.S. SUMMER MEETING

The Summer Meeting which was held at Buxton from May 16 to 19, was an unqualified success from every point of view; the appreciation expressed by the President, Dr. J. N. Aldington, of the work of the organising committee, which included members of the Manchester Centre of the Society, and for all that the civic authorities of Buxton contributed to the arrangements, met with a ready response from all the delegates.

The number of delegates who registered for the meeting was 250, but many members of the Society and others attended particular lectures in which they were interested. Some I.E.S. Centres organised large parties to visit Buxton on certain days. On the list of official delegates were several overseas visitors, including Mr. Ivar Folcker, of Sweden, Mr. Henri Maisonneuve, Mr. Jean Maisonneuve, Mr. Jean Chappat and Mr. and Mrs. Nampon, of France, Mr. Jean Genard, secretary of the Belgian N.I.C., and Mr. and Mrs. Aspestrand, of Norway.

On the evening of Tuesday, May 16, delegates attended an opening reception by His Worship the Mayor of Buxton, which was most enjoyable and which provided an excellent opportunity for delegates to get together right at the start of the Summer Meeting.

On the following morning at the Playhouse, where all the meetings took place, the Mayor officially welcomed the Society to Buxton.

Visual Deception

The first lecture, given on the Wednesday morning, was entitled "Visual Deception," and was given by Dr. L. A. Sayce, superintendent of the Light Division of the National Physical Laboratory. This was a combination of the scientific and the popular, and the audience was able to take part, to some extent, in the demonstrations of stereoscopic effects, etc.

Dr. Sayce began his lecture with a brief description of the manner in which the human eye functions, and then went on to describe how such fundamental knowledge had been applied during the war to the problems of camouflage. In this way our

The second provincial I.E.S. Summer Meeting, held at Buxton from May 16 to 19, was one of the most successful functions, both technically and socially, that the I.E.S. have yet organised. The meeting is reported in the following article; the full text of the papers will shortly be published in the "I.E.S. Transactions."

knowledge of the limitations and behaviour of the eye had been applied to deceive the eyes of the enemy in much the same way as Nature applies colouring to animals to merge them into their natural surroundings or to break up their outlines. Camouflage, whether by nature or design, is achieved by suppression of contrasts, which may be of several kinds: contrast of tone, contrast of form or contrast of colour.

Dr. Sayce also conducted a number of experiments with coloured light and showed the effects of after-images. Before the lecture began, members of the audience were provided with diffraction gratings with which they were able to study the spectra of various light sources.

High-speed photography was also touched upon, and the lecturer showed a number of interesting and amusing films.

Having dealt with various forms of visual deception, which largely resulted from peculiarities of the eye as an optical instrument, Dr. Sayce produced a number of so-called "optical illusions" which are concerned with the mental perception or interpretation of data supplied by the eye. These included the well-known tendency to overestimate the size of divided distances and to overestimate acute angles and to underestimate obtuse ones. Dr. Sayce also carried out a number of interesting perspective demonstrations.

In conclusion, he dealt with stereoscopic vision and with the aid of anaglyph spec-

tacles members of the audience where completely deceived into seeing spiders, baby bears, and the like, swinging out from the stage over their heads.

There was no discussion on the lecture, but Dr. Sayce was cordially thanked on the motion of Mr. J. M. Waldram (Past-President), seconded by Mr. H. C. Weston. (Hon. Secretary).

Dr. Sayce, acknowledging the vote of thanks, said he was indebted to the army of helpers he had had, and he specially mentioned his colleagues at the National Physical Laboratory, Mr. Applebee, Mr. Waldram, the staff of the Playhouse, and all those who had placed apparatus at his disposal for the purpose of his lecture.

Floodlighting

On Wednesday afternoon, Mr. R. O. Ackerley read a paper on "Floodlighting." The chair was taken by Mr. L. J. Davies. During the course of this paper the author illustrated the principles of floodlighting design with the aid of a large model. Having shown various methods of floodlighting on the model and illustrated common faults, the author then showed photographs of floodlighting installations, which illustrated

how these methods had been applied or how certain faults had occurred.

Floodlighting, he said, was in wide use prior to 1939, but since that date, due first to the war and subsequently to fuel restrictions, has been very little practised in this country. It is hoped that the 1951 "Festival of Britain" may see the revival of floodlighting on a wide scale all over the country.

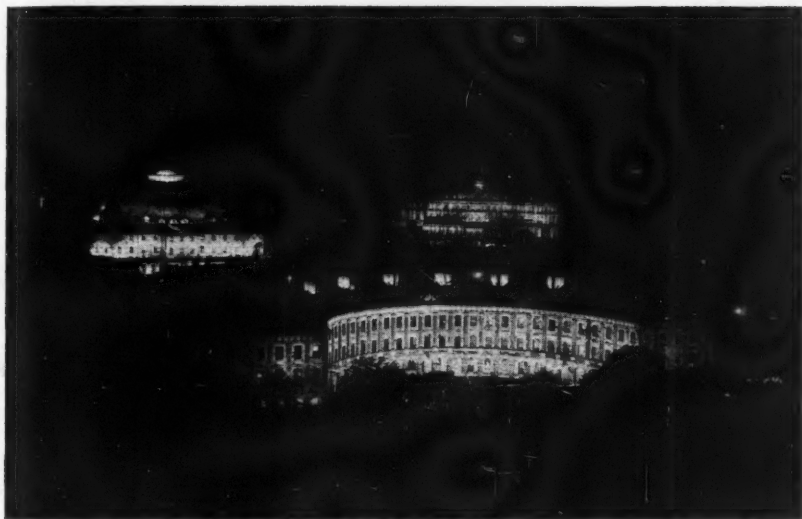
The scene or object to be lighted may be very large or relatively small — but the essence is that the light must be concentrated on a defined area and must not spill over on to the surroundings. The first requirement, therefore, is accurate control of the distribution of light from floodlights. The key to the floodlight distribution is the reflector.

All the light emitted from the floodlight outside the beam is termed "spill light," and much of this can be usefully employed. "Spill light" should be distinguished from "waste light," which is that which misses the target altogether and which may, and usually will, include some of the light within the beam.

The technique of floodlighting involves building up the light over an area with a multiplicity of beams in such a manner



A view of St. John's Church, Buxton, one of the buildings floodlighted during the Meeting.



Showing the floodlighting of the Crescent, the Devonshire Royal Hospital and the Palace Hotel.

that reasonable uniformity of illumination is obtained. In this connection the lighting engineer must study the data relating to the equipment at his disposal. First he will obtain much help from a polar curve of light distribution. Then it will be helpful for him to know the area covered by the beam at typical offsets and angles of elevation within limits appropriate to the particular design of floodlighting. Then it will be useful to know the average illumination which will be obtained over these areas with floodlights at typical spacing-offset ratios.

Data as to the beam lumens and total light output will help to give some idea of the extent to which "spill light" may help in the total build-up. The only additional factor which has to be taken into account is the appropriate allowance for waste light, i.e., light which will entirely miss the target. The percentage allowance that should be made will vary with the circumstances and is largely influenced by the shape of the object to be lighted.

The first thing to be decided in the design of an installation is from what main direction the light should be projected on to the building. A number of factors influence this decision. The angle from which the building is most likely to be viewed is very important. If the main floodlighting

is directed from the same angle, shadows are flattened out and the buildings appear relatively dead and featureless. Next, the architectural features of the building must be considered. The main direction of lighting must be such that fenestration and any projecting features are revealed by appropriate shadows.

Lighting supplementary to the main lighting may be required to relieve shadows or for other reasons such as to reveal parts of a building which the main floodlights cannot easily light—for example, parts of the roof or of the face which are shadowed by projecting building at lower level.

Effective concealment of equipment undoubtedly enhances an installation very greatly, and architects designing buildings which are likely to be floodlighted should make provision for the necessary facilities.

The selection of the most appropriate floodlight for use on any building and at any given offset from it, is a straightforward illuminating engineering problem which any competent lighting engineer should be able to solve.

High intensities of illumination are by no means a criterion of good floodlighting. The correct illumination is determined by many factors, of which the three most important are the function of the building,

its reflection factor, and the brightness of the surroundings. Reflection factors vary tremendously not only with the nature of the material of which the building is constructed, but also with its state of cleanliness.

The paper also included an analysis of the floodlighting installation at Buckingham Palace.

M. Jean Chappat (France), who opened the discussion, said this paper was a stimulant to the old brigade of enthusiasts who carried out such fine floodlighting installations in Europe between the two world wars. At one time or another, before the catastrophe of the last world war every monument of note in Europe was floodlighted either permanently or on special occasions and the public became floodlight conscious. In Paris, after the war, it was only possible to carry out floodlighting on rare and special occasions, but the situation was improving and French engineers were making their plans for a floodlighting revival. This paper indicated that the same thing was happening in Great Britain. Technically, the outstanding installations in France did not differ greatly from British practice, but the architecture had a different character. In addition to the floodlighting of artistic monuments and buildings, however, there was a vast amount to be done in the utilitarian and industrial fields. It was true, as Mr. Ackerley said, that the key to floodlight distribution was the reflector, and he wondered why more use had not been made of reflectors which provided an asymmetric distribution with a sharp cut-off, instead of symmetrical reflectors and glass lenses to change the beam pattern. Recently in France they had had great success with projectors of Swiss design in which multiple sectional reflectors were incorporated and which were elliptical or parabolic, depending on the beam pattern required. The lamp was half silvered and the reflected light from it was controlled by the mirrors of the projector and directed on to the area to be floodlighted. A variety of beam patterns could be produced by adjusting the reflectors. The projectors could be equipped with either 2,000-watt or 3,000-watt lamps, and the reflectors were made of pure aluminium, polished and treated by the "Alzac" process, which resisted corrosion even by sea air. These projectors were normally installed from 200 to 300 feet from the target, but in some cases, by the use of special reflectors, excellent results had been obtained with the units placed at distances of 900 to 1,200 feet. With this system a smaller

number of projectors was required than with the conventional types, and satisfactory results were obtained with considerably less power consumption. For example, to illuminate Notre Dame Cathedral on the façade facing the River Seine, only eight 3,000-watt special projectors were required instead of the 80 1,000-watt conventional projectors formerly employed, and the lighting result was better. Similarly, for lighting the façade of the Chateau de Versailles 10 3,000-watt special projectors did a better job than the 90 1,000-watt conventional units previously used. Many other projects were in course of installation, and he expressed the hope that very soon it would again be possible to describe Paris as "La Ville Lumière."

Mr. J. G. Holmes emphasised the importance of the choice of location of the fittings in floodlighting installations in determining the shadow values and of the avoidance of a luminous atmosphere around the building such as was produced on a misty night. From this point of view he hesitated to think what would be the result if "throws" of 300 yards were used, as suggested by M. Chappat. While there had been little development of floodlighting during the war, there had been considerable development in the design of projectors for high efficiency and high intensity, but in designing these installations care should be taken not to "drown" the buildings with too much light. It seemed to him that the levels of illumination for floodlighting seemed disproportionately high in comparison with those used where work had to be done.

Mr. Grenfell Baines, in some notes read by the President, urged closer co-operation between the lighting engineer and the architect in designing floodlighting installations.

Mr. N. Boydell urged the need for getting away from the "battleship" size of equipment now used for floodlighting. Could not something lighter be designed, possibly by the use of plastics? He also suggested seasonal floodlighting in seaside resorts to include even small boarding-houses, adding that this particularly interested the electricity supply industry, as it was off-peak demand. Colour floodlighting should also be extended. The utilitarian side of floodlighting should be developed more than it had been.

Mr. J. S. McCulloch criticised the author for concentrating so much on the spectacular side and so little on the utilitarian side of floodlighting. He referred to the opportunities in shipyards, where the best results were to be obtained by lighting from



Mr. and Mrs. H. C. Weston being received at the Civic Reception.

Mr. J. A. Robinson, Publicity Manager for Buxton, The Mayor of Buxton (Councillor G. A. Williams) and Mrs. Williams, Mrs. Aldington, Dr. J. N. Aldington and Mr. G. F. Cole.



Mr. and Mrs. H. G. Campbell arriving at the President's Reception.



Dr. J. N. Aldington with Mr. J. M. Waldram and Mr. H. C. Weston

above instead of from below. Experiments were now being carried out on Tyneside with mounting 5, 7, 9 and 10 400-watt mercury vapour lamps on platforms 70 ft. to 80 ft. high, the aim being to give an illumination varying from $\frac{1}{4}$ to $\frac{1}{2}$ foot candles. The management expected this would increase output and save a great deal of wasted time. He believed that a smaller number of larger lighting sources, as mentioned by M. Chappat, would be the best solution of the general floodlighting problem.

Dr. J. W. T. Walsh urged a greater use of floodlighting in connection with gardens.

Mr. C. C. Smith suggested that the uniformity of illumination, recommended by the author, could be overdone. He asked for information as to the advantages of ventilated and unventilated fittings, his experience being that the unventilated type still became very dirty inside.

Mr. J. A. Whittaker thought it would be unfortunate if the Conference was given the impression that a large number of installations could be solved by using a few light sources at a great distance.

Mr. J. M. Waldram asked for the author's views on the floodlighting of fountains and water with coloured light. He had seen Niagara Falls floodlit with white light, and the effect was very marked, but with coloured light the result was likely to appear tawdry. He thought there was too much lily gilding in many floodlighting installations and that

white light was the best, leaving the building or object to provide its own beauty. He hoped there would not be floodlighting all over the place for the sake of floodlighting. Before a building merited floodlighting it should have some aesthetic merit.

Mr. H. E. Bellchambers thought there was quite a field for colour or even the fluorescent lamp in supplementary lighting. On the question of lighting gardens, he mentioned a case of an amateur gardener who had given his chrysanthemums too much artificial light and had spoiled them.

Mr. Ackerley replied in some detail to the discussion and, on the question of larger light sources and fewer of them, said this was an aspect about which more investigation was necessary. He did not think it

would be possible to do anything about the luminous atmosphere due to mist until we could control the weather. He agreed that the criterion of good floodlighting was not how much light could be used but how it was used. He said he would refer to the point made by Mr. Boydell with regard to equipment to the manufacturers! At the same time, floodlighting equipment had to withstand rougher treatment than street lighting equipment. On the question of colour lighting and the use of fluorescent lamps, he thought the great problem there was to project the light from a distance. It might be that the lamp makers could provide fluorescent lamps with the required colour characteristics, but he did not know if they could give higher brightnesses. On the question of unventilated fittings, mentioned by Mr. Smith, he said his experience had been satisfactory provided the fittings were a real engineering job. In floodlighting water in its natural surroundings, as in the case of Niagara Falls, he agreed that white light should be used, but, in the case of fountains, the method of treatment must depend on the circumstances.

Lighting of Fibre and Fabric

On Thursday morning, May 18, a paper on "Lighting of Fibre and Fabric" was presented by Mr. H. Hewitt. The chair was taken by Mr. W. G. Chilvers, of Manchester. The textile industries cover the handling

of a wide variety of fibres, including cotton, flax, jute, hemp, wool, silk, rayon, and nylon, and though each of the industries has its own problems, there is a certain similarity in the general procedure. The seeing task varies with the process and even with the same process using different kinds of material. This paper dealt rather briefly with lighting in all branches of the textile industries, from work on the raw materials to the display of finished articles of clothing in the shops.

Lighting intensities in textile factories have increased considerably during recent years, though the present legal minimum of 6 lm./ft.² is still well below the recommendations of the I.E.S. Code. There are indications, however, of a move towards these later recommendations. For some talks the values given in the Code should be regarded as minima whilst the author suggested that in regard to the clothing industry much higher values are needed for cutting and sewing when dark cloths are involved.

Before the last war, lighting in the industry was mainly by incandescent electric lamps, though gas lighting was frequently to be found. In recent years a large proportion of the lighting has been taken over by fluorescent lamps, though the author points out that it should not be forgotten that there are many industrial interiors which can be and are lighted quite adequately with filament lamps. Fears in regard to stroboscopic effects with fluorescent lamps have been proved to be unfounded. The feature with this form of lighting which causes most trouble is maintenance, and it is found that the average mill electrician is not amused by the complications of lamp faults, etc., and is not quick to diagnose fluorescent lighting troubles. A wider use of the instant-start circuit may help to solve this problem.

It is perhaps in the textile and clothing industries that problems of colour discrimination are presented in their most acute form, and the elaborate colorimetric methods now widely adopted in textile laboratories will have little practical effect unless facilities for accurate colour matching are available at vital stages in the manufac-

turing process. Daylight itself is too variable to give satisfactory results, but recently success has been had with special colour-matching lamps of the hot- or cold-cathode fluorescent type or a combination of fluorescent and tungsten lamps. These sources of artificial daylight are now being used by the industry.

The problem of apparent colour change after purchase of the finished garment has given trouble for many years. The advent of new light sources seems only to have rendered the public more suspicious. Mr. Hewitt suggested that the time has come for a serious study of this problem but apart from one suggestion, which no one is expected to take very seriously, made no contribution towards solving it.

At the conclusion of his paper, Mr. Hewitt demonstrated the effects of various forms of lighting on made-up materials with the use of two full-size shop-windows which had been built on the stage. The demonstration which had been arranged by Messrs. Tootal, Broadhurst, Lee and Co., Ltd., was extremely effective.

Mr. J. W. Howell, who opened the discussion, referred to the problem of lighting textile factories and said that, whilst the author had shown illustrations of modern factories, there were many others of the older type which provided numerous obstacles to good illumination in the way of overhead shafting, and so on. These were

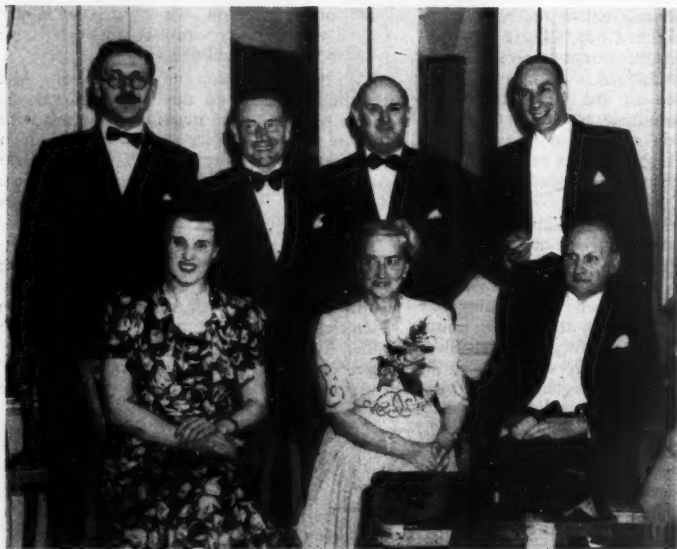


Dr. W. S. Stiles, Mr. Ivar Folcker and Mr. R. Aspestrand (Norway).

gradually being replaced, but it was not possible to pull down mills just to install modern lighting equipment. It was necessary, therefore, to fit the lighting to the particular problem. He mentioned many problems that arise in these older factories and mills and paid a tribute to the co-operation of the textile industry in regard to the I.E.S. Code. Agreement had been reached in both the cotton and woollen industries as to the requirements, and it was hoped to reach similar agreement in the garment industry. The value of this educational work was to be seen in the improved lighting conditions in the

there to adopt fairly high general illumination, and the Americans did not pay so much attention as we do in this country to directional lighting. However, the American mills were usually far more modern than ours. The Americans also paid less attention than we do to background brightness, but they made considerable use of colour as an aid to visual comfort on the part of the operatives. That was also important from the psychological point of view, and should be given more attention here, particularly in some of the older mills.

Dr. H. H. Ballin said he had found that



Among those enjoying the President's Reception—(standing) Mr. P. G. Merritt, Mr. G. L. Comrie, Mr. W. J. P. Watson, Mr. W. T. F. Souther; (seated) Mrs. Merritt, Mrs. Comrie, and Dr. S. English.

textile industries generally, compared with conditions before or even during the war.

Mr. J. S. Jones said he wished the author had had time to go into some of the problems peculiar to the textile industries in connection with which there was a terrific amount of work to be done. He mentioned the difficulties arising in connection with illumination under wet spinning conditions, and said that intensity of illumination was not the important factor in laying out an installation. He regarded the stroboscopic effect of fluorescent lighting as an old bogey, and said he had looked for this effect at first but he did not find it. Commenting on the author's reference to the use of the hot-cathode fluorescent lamp in the American textile industry, he said it was the custom

the standard stove enamel finish of lighting fittings was unsatisfactory under humid conditions, and spoke of interesting experiments that are going on in the use of "Perspex."

Mr. C. J. King referred to a mill in the Glasgow district where there had been complaints of headache on the part of the girls, who said it was due to the lighting. It turned out to be due to bad ventilation, and he warned delegates not to judge the lighting without adequate investigation. In another case a fluorescent lighting installation was under the control of the operatives and an elderly worker at a mending table refused to make use of it, preferring an illumination of 1 ft.c. compared with 12 or 14 ft.c. There was no other reason than that this worker preferred the lower illumination, but it was

bad for her, and, therefore, the lighting installations should be outside the control of the workers, at all events in textile factories.

Mr. F. Jamieson asked for more information on the financial side of textile lighting both as regards cost of energy and maintenance.

Mr. B. C. Robinson spoke of the nylon industry in South Wales and said there were many problems in that industry which were common with those in other branches of the textile industry. There were, however, some special ones. For instance, the first basic process was extruding. Extrusion took place vertically downwards and the extrusion was into the warm air. This, therefore, introduced the problem of seeing the yarn at the time of extrusion and casting the light on the vertical as distinct from the horizontal. For seeing upwards into the spindle they were using small tungsten lamps in swivelling reflectors. The operative must see that there were 10 ends coming down and not nine, and the tungsten lamp-fitting solved that problem. The speeds being of the order of 9,000 to 12,000 r.p.m., stroboscopic effects with fluorescent lamps did not exist. As to the economics of the problem, the annual load factor was 90 per cent., the factory running continuously for 8,600 hours a year, and the overall cost per unit was 0.65d. to 0.7d., current being taken from the public supply. This low cost took into account expensive fluorescent lamp fittings which cost some £10,000 more than a tungsten lamp installation would have done.

Mr. S. Anderson commented on the advance that had been made in lighting in the textile industry since he first investigated it some 20 years ago. Not having had much to do with this problem since, he said he would be interested to know the proportion of mills that were adequately lighted to-day. Twenty years ago he would have put the figure at 5 per cent.

Mr. N. C. Slater said that during a business trip to America a short time ago he was told of two cases in which fluorescent lamps were being replaced by tungsten lamps. In this country, he said, it seemed that we were unable to make up our minds which was the right system to adopt, and he asked: "Just where are we going?" The stroboscopic effect of fluorescent, he urged, should be dismissed from their thoughts because, as an engineer, he believed it had been got over. On the general problem of lighting in the textile industry he thought lighting engineers were misleading and confusing the people without getting to the real point. Lighting engineers and those con-

cerned should really make up their minds whether to keep the tungsten lamp or go all-out for the fluorescent.

Mr. Hewitt, in the course of his reply, said the paper was only a superficial survey and it was impossible for him adequately to reply at the moment to all the detailed points that had been put. He suggested that the bogey of the stroboscopic effect of the fluorescent lamp should be buried so far as the textile industry was concerned. There was a wide use made in America of the cold-cathode fluorescent lamp, and why there was only one such installation in this country was a matter for debate. To cope with the humid conditions in mills, he suggested the use of vitreous enamelled fittings, if the economics permitted. He had had no experience of the use of plastics in this connection. On the question of economics he thought Mr. Robinson had given the answer. As to maintenance, he suggested a weekly brushing down and a thorough cleaning of fittings every two months. The adoption of a standard illuminant for colour matching in the textile industries required the co-operation of very many people, and he hoped the learned societies in the industry were giving some thought to that matter. He thought that something like 30 to 40 per cent. of cotton mills had reasonable illumination at the present time and the majority of the remainder had already done something to improve their conditions. He found it difficult to answer Mr. Slater's question about where we were going for he hardly knew what the question meant. At all events, we should not be over impatient in viewing the general field of lighting at present.

In conclusion, he expressed gratitude for the great assistance he had received from Messrs. Tootal, Broadhurst, Lee and Co., Ltd., in regard to the stage demonstrations, to Messrs. Siemens, whom he had left between the time of submission of the paper and its presentation, and to the North Western Electricity Board, his present employers.

Annual General Meeting

On Thursday afternoon, May 18, the Annual General Meeting was held, the President, Dr. J. N. Aldington, being in the chair.

The Report of the Council for 1949 was unanimously adopted. In presenting it, the President mentioned one or two outstanding matters. He specially pointed out that no applications had been received during the year for the Silver Jubilee Commemoration

Award, and he asked members to impress on their staffs that members under 25 years of age might submit papers which would be considered for the Award. As regards the Register of Lighting Engineers, he said that due to the change in the regulations, there had been a considerable influx of applications, and they were being dealt with as speedily as possible.

It was hoped that during the coming Session it would be possible to have the Inaugural Paterson Memorial Lecture. Consideration was being given as to the best use to be made of the Dow Legacy Fund.

There being no independent nominations for Officers and Members of Council, the Council's nominees were elected.

The President then presented Mr. Howard Long with his certificate of Hon. Membership, and at the same time announced that Hon. Membership had been conferred on one of the Society's most distinguished members, Dr. Ward Harrison, of the United States.

The President recalled that under their constitution the Society were empowered to elect as an Honorary Member anyone who is of acknowledged eminence in some branch of science relating to Illuminating Engineering, or who, by reason of position, eminence or experience, had rendered signal service in promoting the objects of the Society. The number of Honorary Members at any one time is limited to six. Only one such member may be elected in any one year. This honour, the highest that the I.E.S. can bestow, is made to Dr. Ward Harrison in acknowledgement of his numerous and valuable contributions to the advancement of the art and science of lighting, and in recognition of the eminence he has attained thereby.

Dr. Harrison's address to the I.E.S. during their Summer Meeting, at Harrogate, in 1948, will be long remembered.

The award is accompanied by a handwritten citation on vellum recording the election to Honorary Membership.

Lighting In Sweden

Following the Annual General Meeting, a lecture on "Lighting In Sweden, 1940-1950," was given by Mr. Ivar Folcker, Managing Director of the Swedish Lighting Association, and a Vice-President of the International Commission on Illumination. Mr. Folcker is also President of the Swedish Illuminating Engineering Society, an office he has held since 1945.

In opening his address Mr. Folcker stressed that he had no remarkable news to

impart regarding developments in Sweden and pointed out that until 1926 there had been little progress in lighting in Sweden. In that year the Swedish Lighting Association had been formed by the lighting industry to act in an advisory capacity both to the public and to the industry itself. The Swedish I.E.S. was founded in 1942 with functions very similar to the societies in this country and elsewhere.

Good lighting in Sweden is defined as "light without glare, in sufficient quantity, on the right place and of a suitable colour." "Glare" is given first place in this list of desiderata as, whether direct or indirect, it is the most common and most offensive fault to be found. Like lighting engineers in other countries, our Swedish colleagues thought they had this problem well under control—until the fluorescent lamp came along, and now, like us, they have had to think about it all over again. In general, the recommended levels of illumination follow very closely those of the I.E.S. Code. Light in the right place can only be obtained with good planning. With regard to colour, it is the practice in Sweden to use the white fluorescent lamp (3,500 kw.) for illumination levels of not less than 15 lm./ft.², and the daylight lamp (5,500 kw.) at not less than 30 lm./ft.², as it is thought that neither lamp is psychologically satisfactory at values less than these.

The various types of light source are used in much the same manner as in this country, and as would be expected, the introduction of new light sources in recent years resulted in a rise in lighting levels. In Mr. Folcker's opinion the most essential task in illuminating engineering to-day is an honest attempt to get the right lamp in the right place.

Fluorescent lighting has made a great difference to the industry, and to the outlook of the public in regard to lighting. Though much has been done to educate the public, Mr. Folcker said that there was still very much to be done. In offices, shops and factories, etc., practice follows fairly closely on that of this country.

Efforts to improve home lighting resulted only in improvements in lighting in kitchens. Mr. Folcker said that two important matters needed attention before much progress could be made in home lighting; first it was necessary to modernise the wiring systems in houses so that the householder could have lighting points where he wanted them; and secondly, it was necessary to design fittings which were both technically and aesthetically satisfactory.

In dealing with some of the investigations



Out for a stroll — Mrs. J. G. Holmes, Mrs. C. W. M. Phillips, Mrs. A. D. S. Atkinson and Mrs. N. Boydell.

Some of the ladies photographed before leaving for a visit to Haddon Hall.



Mr. H. Etchells with some of the ladies from the Liverpool and Manchester Centres.

now being carried out into lighting matters in Sweden, Mr. Folcker said that as lighting progresses, so will the number of problems to be solved increase. Many of the problems will be due to the fact that lighting technique, in a much higher degree than any other technique, has to take the human factor into account.

In conclusion, Mr. Folcker recalled that the next meeting of the International Commission on Illumination was to be held in Stockholm in June next year, and he expressed a warm welcome to visitors from this country.

Mr. Folcker was cordially thanked at the end of his lecture on the motion of Dr. J. W. T. Walsh, seconded by Dr. S. English.

The President's Reception at the Palace Hotel in the evening was well attended, and was a most enjoyable function.

Stage Lighting

On Friday morning, May 19, Mr. L. G. Applebee presented a paper on "Stage Lighting in the Post-War Theatre in Great Britain," Mr. C. R. Bicknell presided.

Stage lighting, he said, always carries an atmosphere of something deeply mysterious or magic, and it is said to be an art. It is easy to overlight, but a brilliant all-over intensity or glare that renders the scene "flat" in appearance is inartistic. Not only must the actor be visible, but his features must be given "plastic" expression. It must also be remembered that a slight change of the direction of the light that strikes an object or actor can entirely change the "expression." This makes the lighting dramatic. Some indication of the elaborate arrangements for emphasising various points where light is required were gauged from these figures: "The Death of a Salesman" at the Phoenix Theatre, employed approximately 150 directional units controlled by 132 dimmer ways, while "A Streetcar Named Desire" used 168 directional units controlled by 117 dimmers.

The footlight was, and always had been, a bone of contention. In some of the spectacle types of theatres, additional lighting had been fitted in the auditorium to give cross beams of light catching the side of the actor's face, and footlights had been dispensed with. The lighting of the acting area is by directional lighting units situated in several positions including: (a) On the circle fronts in the auditorium; (b) on the spot batten, which is situated just behind the proscenium opening, and (c) over the stage.

The cyclorama, he explained, consists of a lighted screen which has to produce to the

audience the illusion that one is looking at a real sky. There must be a sensation of depth, of looking out into vast space. In some cases a curved type of canvas carried on a circular track is employed. Although this method was much used on the Continent, only four examples are to be found in England. There are also restricted portable canvas cycloramas which are flat with curved ends. Lighting of the cyclorama must be even; for the top lighting wide-angle floods of not less than 100 deg. beam angle are usually employed, the result being that each lantern projects layer upon layer of light on the surface.

The various lighting circuits on the stage have to be controlled, switched on and off singly or in groups from some central position. More important, the circuits have to include dimmers so that the intensities can be regulated and balanced. Reduction in light is effected by reducing the voltage applied to the lamps. There are four types of dimmers in use to-day: resistance, auto-transformer, indirect electronic and direct electronic. The resistance is still the cheapest and simplest dimmer to construct. Whatever the form of the dimmers, their control handles require to be assembled for individual and group manipulation. Dimmers are seldom few in number, and arrangements have to be made to lock the handles together for group operation, preferably by one man. Number of dimmers installed in various theatres: Drury Lane Theatre, 216; Stoll Theatre, London, 176; New Theatre, London, 144. There are certain types of spectacular shows in which the number of dimmers is not only very high indeed, but large numbers of changes follow rapidly. An attempt has been made in America to solve this by adding six to ten pre-sets, which means that for a board of 200 dimmers there are 1,200 to 2,000 dimmer levers. In England the light console was yet another solution for this kind of problem. This does not provide pre-setting of dimmers but aims to place all controls convenient to the hands (and feet) of a seated operator, who can group them rapidly as required. To this end an organ console with stop keys and keyboards is used. Basically the system differs from others in that the individual dimmer control lever, position scales, circuit switches, locking switches, etc., are replaced by a single switch (stop key) per circuit. This stop key locks its own lighting circuit, and any others whose stop keys are down, to a master keyboard for movement.

British stage lighting apparatus, said the author, is as good as, if not better than, any

produced in other countries. It is constantly being revised and redesigned by the manufacturers to produce the most efficient units.

During the course of his paper, Mr. Applebee demonstrated the use of various kinds of stage lighting equipment and showed the care that must be taken to obtain the right effect. He also very cleverly demonstrated the effect of coloured light on make-up.

Mr. Christopher Ede, actor and producer, discussed the whole problem of stage lighting from what he called the customer's point of view. He said the theatre was not a well-organised industry, for actors and producers had to work under all sorts of conditions and with all sorts of different equipment. Ninety-five per cent. of the labour was casual for, indeed, actors were casual labourers. It was very easy to get excited about lighting, but it was also very dangerous. No bad play had ever been made good by good lighting, although a few good plays had been made bad by bad lighting. Nevertheless, adequate lighting was essential, for it was a fact that if an actor was speaking in the dark the audience invariably said they could not hear him. Emphasising the difficulties of the producer and the need for great flexibility in the lighting equipment, he said that, having presented a certain play in a well-equipped theatre, he had to do the same production in two months' time in a tent seating 9,000 people. He made a plea for the pre-focus cap for projector lamps and spoke of the difficulties of the electrician when a lamp went, usually at the wrong moment, and the problem he had in first finding a new lamp and then focusing it correctly. In rehearsals this involved a large number of artists hanging about doing nothing, and there was generally a waste of time, money and temper. The producer was not interested in balance of phases or heat losses. He wanted light at the right intensity at the right moment and tremendous flexibility. The most important development since the war was the electronic switchboard, for it enabled the right intensity of illumination to be provided just when and where it was required. Therefore, he looked forward to the time this new switchboard would be generally available to every theatre.



Enjoying a chat over coffee are, left to right, Dr. J. W. T. Walsh, Mr. H. G. Campbell, Mr. R. Aspestrand, Mr. I. Folcker, Mrs. Aspestrand and Mr. J. G. Holmes.

But theatre owners would not throw out their equipment just to have something new. The industry was not organised, it lived from hand to mouth, and perhaps to many people the whole industry must seem a little crazy. Finally, he said that when on tour the producer wanted to feel satisfied that his lighting equipment, when it had to be carried about, as was often the case, would not be smashed up on the railway.

Mr. J. Hodgkinson, also an actor and producer, and at present Regional Director to the North-West Counties for the Arts Council, said that the tendency was to make lighting equipment so elaborate that the stage electrician was becoming the most dangerous man in the theatre. Therefore one of the most important things at present was to get back to first principles and to really understand what stage lighting was for and what the stage electrician was for. The job of the stage electrician was to enable people to see what was going on, and stage lighting must emphasise that what was taking place had a certain architectural quality. Here the electrician had the job of trying to make things have a stereoscopic relationship to one another. A further task of stage lighting was to give significance to the art that was being portrayed, but the technique of the thing should not be visible at all. That was the answer. If the installation was right then it was not noticed at all. He contrasted the problems of the large theatres with those of the smaller ones and of small halls, and said

the latter were not given enough attention by engineers. He also pleaded for flexibility of equipment and suggested that for manufacturers of the equipment to get an idea of the difficulties of operating it under restricted conditions they should undertake the task themselves. He also mentioned the problem of heat from lighting installations, and said that some stages were like ovens after a very short time. Perhaps the fluorescent lamp would help here.

Dr. L. du Garde Peach, who has his own theatre in which he carried out experiments in lighting and other matters, also spoke of the need for flexibility of equipment. He emphasised the need for giving a three-dimensional effect and of angling the spot lights, thus giving "life" to the stage and avoiding a flat effect. Switches on the stage board, he said, was asking for trouble unless there was a very competent electrician. Dimmers were much better because by putting the current slowly into the lamps the life of the lamps was lengthened. He pleaded for the simplest possible kind of equipment and installation and finally said that whilst producers were trying to understand the problems of the lighting engineers he hoped the latter would try to understand the problems of the producer.

Mr. E. E. Faraday said there was plenty of opportunity for manufacturers of stage lighting equipment to simplify their products, particularly equipment for small stages. Lamp makers should also try to produce new sources of light. Fluorescent lighting gave some hope in this direction and he believed the equipment manufacturers would welcome a lead from the lamp makers in that respect. Too much attention had hitherto been paid to the large theatre whereas the small ones should be the starting point.

Mr. C. T. Kingsley-Lark, remarking that the great technical advance of the electronic dimmer had rather overshadowed the potentialities of the d.c. saturated choke, said that about five years ago he applied the d.c. saturated choke for the light output control of fluorescent lamps. Initially, the equipment was limited to auditorium lighting only and several installations had been in operation for considerable periods. Recent development in coloured lamps, however, had greatly advanced the prospects of applying the method to stage lighting.

Dr. J. N. Aldington, replying to the first three speakers, said that a great deal of research into stage lighting was now going on but he felt he must make it clear that there was not even a remote chance in the immediate future of more intense light

sources for use in the theatre world. On the question of heat, he said, there must always be an emission of heat from an electric lighting installation. Nevertheless, there were indications in the research field of serious developments which might assist in these directions though some of them might remain in the laboratory stage for many years yet. He added that the pre-focus cap was invented 20 or 30 years ago and if it had not yet reached the theatre there would seem to have been some lack of persuasiveness on the part of Mr. Applebee and his colleagues!

Dr. J. W. Strange asked if there had been any marked developments in the reliability of the thyatron control circuit. The questions of heat, consistency of control, colour, etc., in the case of the fluorescent lamp could be met to a considerable extent by the use of lightweight fittings and he added that the reduction of heat emitted in the case of the fluorescent lamp compared with the tungsten lamp had to be experienced to be understood.

Mr. Applebee, in his reply to the discussion, agreed with all that had been said with regard to simplicity and flexibility, and reminded those speakers that for the small hall he had devised a switchboard with dimmers which sold at from £35 to £50. Against this, an equipment such as that at Stratford-on-Avon cost £2,000. The complaint of the manufacturers was that the equipment for small halls was available, but those concerned had not the money to buy it although the cost was low. Obviously, consoles were for the large theatres, but they were not complicated to operate. At the London Palladium the console was operated by a girl, and, once the operator got to understand it, there was no rushing about of stage electricians such as had been hinted at. He appreciated the difficulties of the lamp makers in producing new light sources. The problem in stage lighting was the life of the lamps; the light output could be increased by suitable reflectors. In the case of the large theatres, the saturated choke had been dropped when electronic control came along because of its many advantages in regard to proportional dimming and the dissipation of heat.

Street Lighting

The final paper on Friday afternoon, May 19, was "The Development of Street Lighting in Great Britain," by Mr. J. M. Waldram. The President was in the Chair.

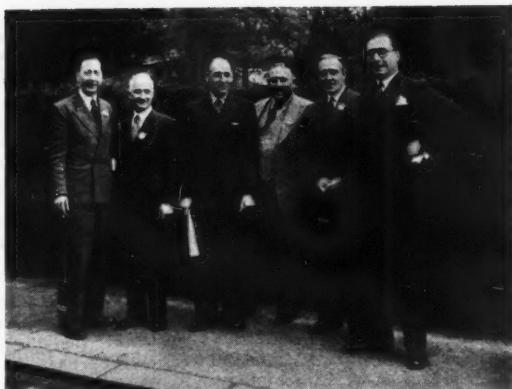
The author began by saying that the art

of street lighting in Great Britain has progressed since the early 1920s in distinct stages, each of which was marked by an event which forms a milestone. From the time when the matter was first considered as a technical problem until about 1932, street lighting was treated as a problem in illumination on lines very similar to those employed in lighting interiors. An important milestone was the British Standard Specification issued in 1927 and in revised form in 1931. In 1928 Mr. J. F. Colquhoun's series of installations in Sheffield gave impetus to studies which were already becoming intensive, and anomalies were found which cast doubt upon the illumination basis of rating used in the Specification and upheld by the British Delegation to the meetings of the I.C.I. In 1932, discharge lamps began to make their appearance, and gave much greater incentive to the study of street lighting. Their mechanism was explored and explained; the properties of street surfaces and their action was studied; and by 1934 a fresh approach was outlined, based upon luminosity (brightness) rather than illumination, and upon perspective instead of plan.

Two distinct lighting systems now emerged, one originating on the Continent and having as its aim the elimination of glare, known as the cut-off system, and the other originating in this country which aimed at high road brightness and high contrasts, known as the non-cut-off system. These two systems, and an intermediate one, are still distinguished.

In 1935-37 another milestone appeared in the Ministry of Transport Departmental Committee on Street Lighting, which studied the subject afresh and issued a Report in 1937 which has been in effect the Code of Practice of this country since. Its recommendations differed sharply from the provisions of the British Standard Specification, and it has had a marked and unifying influence upon British practice. Work done for the Departmental Committee threw more light upon the mechanism of seeing in streets at night.

The art of street lighting has become less and less suitable as an object for specification; and the B.S.I. which laboured for some



A group of delegates including Alderman Alex Critchley, A. Owen, N. B. Harrison, K. R. Mackley, C. C. Smith and R. G. Crammond.

years to produce a specification implementing the recommendations of the Ministry of Transport Departmental Committee, finally decided to produce a code rather than a specification, a document which it is hoped will shortly appear.

Three distinguishable systems of lighting for traffic routes exist at the present time, which are discussed. The non-cut-off system is suited to our narrow and winding roads and is cheap and flexible; it can be "tailored" to fit the road better than can either of the other two. It suffers from more glare than the others. The semi-cut-off system is adapted to more formal thoroughfares with opposite mounting, or to tree-lined roads where central mounting at normal spacings is necessary; it gives somewhat less glare than the non-cut-off system. The cut-off system is designed to reduce glare to a minimum: it requires central mounting with a short and rigid spacing and cannot be "tailored" to fit the features of the road, but produces a very comfortable and attractive result. For the lighting of one-way and double-carriageway roads, a unidirectional system has been produced applicable to any of the three systems above described, and having many advantages.

Modern lanterns have departed from the spun and built-up sheet metal constructions formerly used, and are made from aluminium die-castings which are strong and accurate. Improved designs have resulted in much more rigid, stable and convenient lanterns. Sodium and fluorescent lamps

have permitted the use of plastics which in turn permit new constructions and simplifications.

Outstanding problems include the lighting of residential roads, in which there is not enough light available to do all that is obviously necessary; lighting of wide roads and bridges; lighting of arterial roads; and problems of control of large numbers of lanterns from a central point.

Mr. F. C. Smith, opening the discussion, said he had not always agreed, and for that matter still did not agree, with the emphasis which Mr. Waldram and his collaborators had placed on certain aspects of street lighting, but that in no way detracted from his admiration for the pioneer work that he and his co-workers continued to make available to all interested in public lighting, including his own industry, the gas industry. No mention was made in the paper to the contracts placed for both electrical and gas installations prior to 1920, but these represented a complete breakaway from what was then the established practice of purchasing units of electricity or cubic feet of gas and substituted requirements as regards both candle power and distribution. That was the new approach to the street lighting problem. On the question of glare, he said we in this country were prepared to accept more glare than was the case on the Continent, but it was possible to get the best of both systems by choosing a system which might be termed "partial cut-off." The glare in many installations here was excessive, a source of discomfort, embarrassment and fatigue to the driver. He was less worried by a system which might produce somewhat patchy effects on the road, but which was relatively free from glare, than by an installation which had fairly even road brightness but had excessive glare.

Dr. J. W. T. Walsh made an appeal that more attention should be given to the lighting of residential roads which required a different method of approach from that for traffic routes. He asked that information on such installations which could be regarded as highly successful be made available.

Mr. N. Boydell asked for consideration to the problem of colour distortion which did not matter on traffic routes but was of great importance in shopping streets. On the question of road surfaces, he suggested that a joint meeting of illuminating engineers and road engineers should be held to discuss this problem. He thought the 4-ft. housing of fluorescent lamps was very

ugly and for shopping streets he urged a development of the 2-ft. fitting.

Mr. Grenfell Baines also urged co-operation between road engineers and lighting engineers and said he would like to be in at the "party." He felt there should be fewer lighting units, but how that was to be done and maintain efficient lighting was up to the engineers. Personally, he was interested in the appearance of things, and did not think there could be anything worse than bright road surfaces. Finally, he said architects and engineers wanted to understand something of the fundamentals of the science and he himself hoped to put over an understandable definition of his art so that the two sides should come together.

Mr. J. A. Whittaker suggested that larger lanterns, although perhaps greater in capital cost, would give compensating advantages in use.

Mr. Waldram, replying to the discussion, agreed there would be some advantage in larger size lanterns but they would not be dramatic. The facts and figures were known, and it was possible to estimate in advance what the result was likely to be. Mr. Grenfell Baines was a great friend of his, and he would say to him that he would be wise to understand the technical problem before he tried to suggest a solution. The aesthetic side was undoubtedly very important, but he did not mention it in the paper because not much work had been done on it. It seemed to him likely that a solution in that respect would not be reached until it was no longer a matter of co-operation between the man of aesthetics and the man of science, but until they co-existed in one person.

For shopping streets a combination of tungsten and fluorescent lighting had been quite successful. He looked forward to collaboration between the road engineer and the lighting engineer, as suggested by Mr. Boydell.

If he did not refer adequately to the early Westminster contracts, mentioned by Mr. Smith, it was because he was not on the job then. On the question of glare, he said there was a swing of the pendulum compared with the early days when we were very keen on preventing glare in this country but it must be considered in relation to safety as well as comfort.

Conclusion

On the conclusion of the last paper, the President brought the Summer Meeting to a close. Before doing so, however, he

(Continued on p. 235)

French Recommendations for Street Lighting

The following article reviews the recently issued recommendations for street lighting which have been prepared by the Association Française des Eclairagistes for the French Ministry of Reconstruction and Town Planning.

As briefly noted in the April number of this journal, a quite extensive code of good practice in public lighting has recently been issued by the French Ministry of Reconstruction and Town Planning. In view of the imminent issue for comment of the British Draft Code which has been in preparation for so long, it is interesting to consider the recommendations contained in the present document which is the work of a special committee of the French Illuminating Engineering Society. In the foreword emphasis is laid on the importance of local conditions and it is envisaged that in present (presumably financial) circumstances, the standard considered appropriate in any particular locality may fall short of that recommended, even to the extent of a reduction to beacon lighting after a certain time of night. Nevertheless, the cables laid should be of sufficient size to enable the full standard to be achieved without undue difficulty when this becomes practicable.

The first chapter is a very clearly written introduction to the subject of lighting, concluding with sections on visibility and glare. The function of good street lighting is well stated to be, not only the provision of adequate illumination, but equally the creation of conspicuous contrasts between objects on the street and their backgrounds, so that they become readily visible. The way in which the visibility so achieved can be effectively destroyed by glare from the lamps is well described.

The second chapter is a brief but effective treatment of the subject of road surfaces and the way in which their reflection characteristics affect the form of the light patches seen by an observer in any given position

with regard to the street lamps. It also contains a paragraph on contrast reversal and suggests as a remedy the elongation of the bright patch from a lamp towards the observer by raising the angle of cut-off. This, of course, has the effect of increasing glare and the far preferable alternative of decreasing the spacing is not mentioned.

The next chapter is by far the least satisfactory of the whole document. It attempts to deal with light distribution within the compass of two pages out of a total of 42 and it gives the impression that the subject has been much less fully studied in France than in this country; it certainly gives the reader very little help towards choosing from among the various distributions available that one which will best suit his special conditions and give him the nearest approach to the effect he is attempting to achieve. It is stated that the angle of maximum intensity lies between 70 deg. and 78 deg. from the downward vertical "according to type." Nothing is said here about angle of cut-off and in fact the cut-off type of street lantern is completely ignored.

A note on the front cover of the code states that the Ministry responsible for issuing it will welcome criticism and suggestions and most street lighting engineers in this country will feel that this chapter on light distribution should be entirely rewritten at much greater length. It might with advantage give some treatment of the different types of light distribution available and describe the particular features of each, which the lighting engineer needs to consider when endeavouring to assess its merits or demerits for his special case, as well as the conditions to be observed if it is to be used to the best advantage.

The next chapter is a long one dealing with height and spacing. The advantages of close spacing are well set out and a spacing/height ratio not exceeding 4.5 is recommended in general, with reduction to 4 in the case of extended sources of low brightness such as sodium lamps. There is much

more flexibility as regards height than in this country but 25 ft. appears to be favoured. The arrangement of the posts is dealt with in some detail. Roads are divided into two categories according as their width is or is not greater than 1.5 times the mounting height of the lamps. For the narrower class, single-side lighting is approved though the staggered arrangement is preferred. Single-side mounting possesses considerable practical advantages, particularly as regards first cost and especially where the supply is carried by overhead cables. It is in no case suitable for the wider roads. Further, the mounting height in such roads should be not less than one-third of the width of the carriageway. There is an interesting discussion of lighting from lamps mounted on short posts, and the objections to a system of this kind are pointed out.

With regard to overhang it is suggested that lanterns should not be overhung by more than two to three feet except in the case of tree-lined roads, when an overhang up to as much as eight ft. is recommended. Incidentally, there is a short chapter on the effects of tree-planting on street lighting, a subject which is probably of even greater importance in France than it is over here. With regard to bends and road junctions, very little guidance is given to the designer of an installation and this again is a part of the Code which might well be elaborated in a subsequent edition.

A very short chapter on classification divides roads into three classes by the volume of traffic they carry and the accompanying table gives the lamp lumen output per square metre of road surface which is considered appropriate to each class. Although it is stated in the text that the appropriate mounting heights and arrangements of the lamps are also given, no such details are, in fact, included. They are, however, to be found in a table appended to an earlier chapter, viz., that on height and spacing.

Next there is a short but very interesting chapter on the lighting of road tunnels. Two very practical suggestions made are (a) that the value of the tunnel illumination should be related to the external illumination by means of a photo-electric control and (b) that the external illumination within 30 yards or so of the mouth of the tunnel should be graded by means of an external structure with, presumably, a gradually diminishing daylight factor. The following chapter, on the focusing of light sources, makes a strong plea that adjustments in three directions should be provided instead of the simple

adjustment in one line only which is so common.

The next five pages form a chapter on light sources. Details are given of the different types used for street-lighting, both their electrical characteristics and their mechanical dimensions being tabulated. The final section of this chapter describes the fluorescent lamp and this leads on naturally to the next chapter which deals with public lighting by fluorescent lamps. It refers to low-voltage installations in England and in Paris and mentions experimental work now in progress on the use of high-voltage tubes.

The next chapter deals with posts and other supports for the lighting fittings. Posts may be of cast-iron, of steel or of concrete and each material has its particular merits and demerits. The cast-iron post is cheap and has a long life but it is inherently weak as regards resistance to shock. Heights are limited to about 18 or 19 ft., although with a steel core cast iron can be used up to a height of some 23 ft. Steel posts, on the other hand can be used for all heights up to about 33 ft. but they require much more frequent and careful maintenance. An important warning is given that any fixing holes or other discontinuities in the surface should be made *before* the steel surface is treated. Concrete posts give very satisfactory service, though the opening at the base, if the supply cables are underground, may be a region of mechanical weakness. Similarly, extraneous ornament is likely to cause weakness and liability to corrosion and should generally be avoided. Bracket arms may be fixed to posts, particularly where it is necessary to bring the light sources clear of trees and foliage. They can also be used on buildings at the sides of the road when the pathway is so congested as to make the erection of posts inconvenient. The length varies from 18 inches to 15 ft.; for lengths of over 6 ft. tie-rods are necessary and in the case of very long bracket arms attached to buildings, side supports should be fixed to resist movement due to windage. Apparently, since 1935 municipalities in France have had powers (subject to certain condition) to fix bracket-arms to buildings for purposes of street lighting.

In a short chapter on accommodation for accessory apparatus, such as transformers, it is recommended that this should be built in wherever possible, its precise location being settled in consultation with the authority responsible for buildings. This should take place at as early a stage as possible, preferably when the installation is

being planned. Following this is a chapter on the materials used for accessories such as circuit-breakers, cable junctions, and the like. It is pointed out that an installation may well include a large number of such small elements, and the failure of any one can cause an interruption of service and much inconvenience. It is therefore recommended that suitable materials should always be employed. In particular, cable junctions which are subject to mechanical stress should be designed to withstand the maximum stress anticipated and should be constructed of copper or a bronze (such as an aluminium bronze containing 92 per cent. of copper) and not of brass or steel. Similar detailed recommendations are made as regards other accessories. A brief chapter then follows on non-oxidizable metals and on the methods by which ferrous metals can be treated so as to render them partially or wholly immune from atmospheric corrosion. The different forms of treatment are listed and it appears that, as in this country, there is no general agreement regarding the one considered to be most suitable or effective.

The next chapter, on maintenance, opens with the somewhat naïve statement that "if all the rules regarding installation have been observed and if the equipment has been properly chosen and is of good quality, maintenance will be simple." It would be interesting to hear the comments of the public lighting engineers in some of our large cities. However, the chapter itself gives good advice and deals with the matter under the five headings of

- (i) Lamp replacement
- (ii) Maintenance and checking of control devices
- (iii) Maintenance of the system
- (iv) Supervision of the system
- (v) Repairs

Under heading (i) group replacement is recommended while under (ii) it is emphasised that periodical checking is just as important as maintenance proper. Heading (iii) includes not only maintenance of the supply network but also such matters as repainting and the cleaning of globes. Supervision takes the form of periodical inspection for obvious faults and includes making a note of any opening of the roadway, in case this should give a clue to the location of a subsequent fault.

The final chapter is a long one dealing with methods of supply to the lamps. In particular the respective advantages and disadvantages of overhead and underground

lines are compared at some lengths and it is clear that the former system is one which has to receive very careful consideration in French street lighting. Next, the various systems for lighting and extinguishing lamps are described in some detail for the two cases (a) when the street-lighting is on a special network and (b) when it is on the public supply network. There is no reference to photo-electric control systems.

The whole document is, speaking generally, a most useful one although there are certain noticeable gaps. One of these has already been mentioned; another is that central suspension is scarcely mentioned and there is no discussion of its merits and dangers or of the special conditions under which it may be used with advantage. The lighting of roundabouts is not touched upon, neither is there any mention of dual carriage-ways. The treatment of the subject is, however, very sound and it is "put over" with admirable clarity. A comparison with the draft British Code when this appears will be both interesting and instructive.

Personal

MR. J. A. PROWSE, who has been a technical officer on the staff of the Electrical Development Association since 1937, has been appointed Domestic and Commercial Development Engineer of the No. 4 (Preston) Sub-area of the North-Western Electricity Board and takes up his new post early in July. Mr. Prowse entered the lighting field in 1926 with the North-Eastern Elec. Supply Co. at Newcastle-on-Tyne.

MR. H. C. WHITE has been appointed Commercial Manager of the Light Group of Philips Electrical, Ltd., and Mr. R. P. SAYERS has been appointed Assistant Commercial Manager. Mr. White joined Philips as a lighting representative twenty years ago, subsequently having charge of their special lamp department. He managed the Manchester branch for ten years. Mr. Sayers was with Holophane until 1934, when he joined Philips to develop applications and sales of discharge lamps and lighting.

MR. C. J. MISSELBROOK has been appointed manager of the I.E. Department of Siemens Electric Lamps and Supplies, Ltd. He was with the Holophane Company from 1935 until 1937 when he first joined the Siemens organisation. In 1948 he went to Troughton and Young (Lighting) Ltd. as Senior Illuminating Engineer, where he remained until taking up his present appointment.

Lighting at the B.I.F.

Two novel display pieces formed prominent features of the British Thomson-Houston Company stand at Castle Bromwich. One, a self illuminated "Pillar of Coloured Light," constructed entirely of the newly developed Mazda coloured lamps, showed in a very effective manner the vividness of these light sources. The other, also a pillar, was formed by an arrangement of the more familiar colours of fluorescent lamps indicating the various sizes available in each.

Among the wide range of lamps shown on this stand, was a new tungsten filament lamp, the 100-watt Silverlight Lamp. This, the same size and shape as its clear equivalent, has a coiled-coil filament and the silica coating on the inside of the bulb gives a diffusing finish similar to that obtained with opal glass but without its appreciable curtailment of light. New instant start 40-watt fluorescent lamps were also displayed for the first time.

A self-contained streetlighting display showed various types of streetlighting lanterns including the new 2 ft. fluorescent lantern for

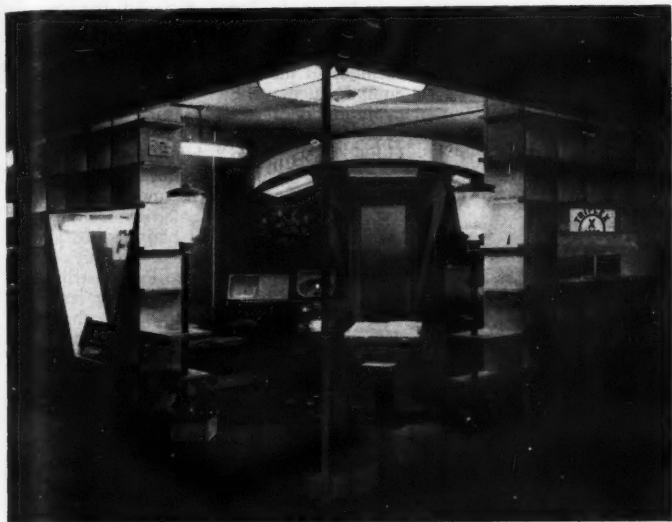
This year the twenty-ninth British Industries Fair, held during May, was the largest yet staged. Thousands of home and overseas buyers visited the London and Birmingham sections, where, as usual, a number of firms in the lighting industry exhibited.

side street lighting. This is another unit being seen for the first time at the B.I.F. Interesting photographs of some B.T.H. streetlighting installations at home and overseas were shown. Examples of Mazda streetlighting lanterns were also seen mounted on poles at the site of the pole display outside the exhibition building.

Another special feature of interest was a display of the principle followed in the installation of a specially designed lighting scheme for a large automobile manufacturing concern. It showed how complete flexibility is achieved as to the type, wattage and positioning of the lighting equipment, and



The British Thomson-Houston Company's stand at Castle Bromwich.



(Left.) The "Triplex" Safety Glass Co., Ltd., showed a wide range of mouldings for all types of lighting fittings.

(Below.) The square beam location beacon shown by Chance Bros. Ltd.

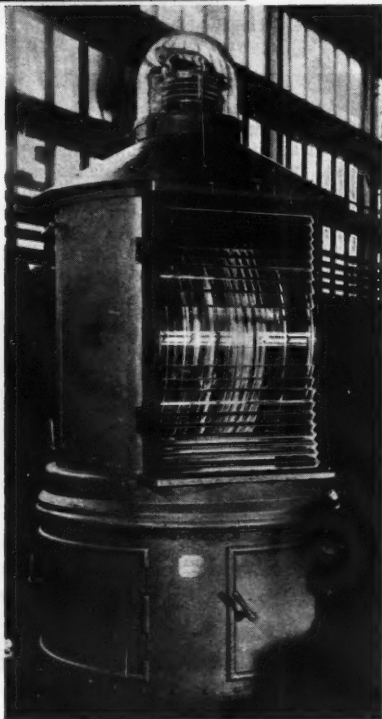
how provision is made for carrying gear for a variety of other services such as telephones, fire alarms, loudspeakers, clocks, etc., all within the same channel. The system is known as Universal Trunking.

Chance Brothers, Ltd., exhibited for the first time their square beam location beacon which has been approved by the British Air Ministry for standard use in British Civil Airports. The advantage of this beam is that from whatever altitude angle it is viewed, up to the limit of visibility, the breadth of the beam is the same and the duration of the flash is constant. Under clear weather conditions it has a luminous range up to 60 miles. The beam has a peak intensity of 2.5 million candle power and a flash duration of 0.2 seconds.

Falk Stadelmann and Co., Ltd., were showing new industrial switch boxes as well as lighting fittings. These included weather-proof floodlights and three new commercial fluorescent fittings incorporating fluted clear "Perspex" diffusing screens. One of these, the "Moray 2580" is designed primarily for mounting flush with the ceiling. The enclosure is easily removed with one hand which facilitates quick access to the lamps and control gear.

The exhibits of The General Electric Company, Ltd., included airport lighting equipment, and street lighting equipment.

The main feature of the airport lighting display was a working, scale model of part of

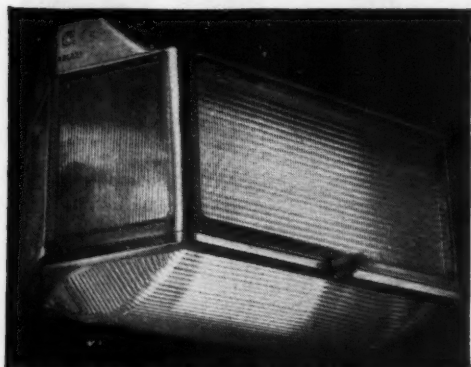




(Above.) The new B.T.H. Company's fluorescent streetlighting lantern which houses two 2ft.-40 watt lamps.

(Right.) Ekco-Ensign Ltd. showed this decorative fitting which uses two 4ft.-40 watt lamps.

an airport, completely equipped with airport lighting apparatus. Shown on the model was a section of the instrument landing runway; a complete approach lighting installation; a taxiway; a terminal area, and various auxiliary services, all complying with the recommendations of the I.C.A.O. Actual working examples of the various lighting units shown on the model were displayed

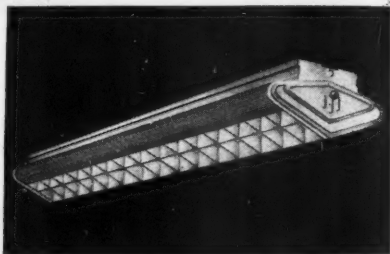


The G.E.C. "Viatron" lantern for arterial and trunk road lighting.

in addition to lights designed for special applications.

To illustrate the application of its research facilities to the production of street lighting equipment, the G.E.C. showed stages in the evolution of a street lighting lantern. The exhibit included a "mock-up" of the G.E.C. "Dioptrion" lantern to show the care taken in its mechanical, optical and electrical design; lanterns undergoing actual tests associated with lantern vibration and climatic conditions; and photographs showing recent installations of G.E.C. street lighting equipment and the light distribution curves of the latest street lighting lanterns. In addition, samples of alloys were shown to demonstrate the harmful effect of corrosion should the wrong type of alloy be used in a lantern's manufacture.

Street lanterns displayed included the "Three-Eighty" refractor lantern; the new Post Top mounting lantern; a totally enclosed sodium lantern; a "Viatron" lantern and a "Dioptrion," or double-dish lantern.



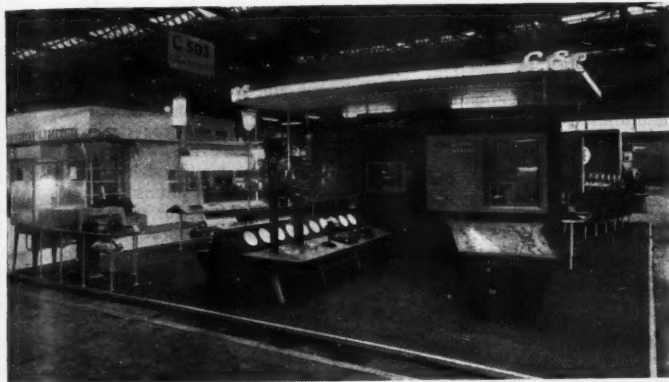
Primarily for side street lighting the new G.E.C. Post Top mounting lantern on a 3 in. x 3 in. spigot is designed to take low wattage Osram B.C. or E.S. filament, or, H.P.M.V. lamps. The top of the lantern can be removed without disturbing the focusing gear and dome refractor which are carried on two vertical rods from the lower casing. The lantern is totally enclosed in reeded "Perspex" of a conical form, and a pressing of diffusing opal "Perspex" allows light to fall immediately underneath the lantern. The "Viatron" lantern is a new lantern designed for arterial and trunk road lighting.

The Revo Electric Company, Ltd., showed an interesting selection of fittings and particular attention was given to the Revo "Tru-

folite" and "Fullalite" reflectors which illuminated the stand. New designs in decorative fluorescent fittings were featured, both on display and for illumination purposes. A selection of Revo street lighting fittings comprised patterns for use with tungsten filament, sodium vapour and mercury vapour lamps. The "Silverblue" lantern and Revo "Sol-ern" fittings for

dential purposes as well as for the lighting of public buildings, hospitals, theatres, cinemas, etc. Among the lamps seen was a twin 4 ft. lamp of the batten type, so designed that it can be easily adapted by the addition of diffuser attachments for use in shops and department stores.

Other exhibitors of lighting equipment included Auto Diesels, Ltd.; Berry's Electric,



Included in the stand of the General Electric Co., Ltd., (left) was a model of aerodrome lighting.

(Right) Ekco-Ensign Electric Ltd., showed all types of commercial and decorative fittings.



fluorescent lamps also formed part of the display. At the entrance to the fair buildings, various types of street lighting fittings and lanterns were displayed together with concrete and cast iron standards and brackets.

The principal exhibits on the Thorn Electrical Industries, Ltd., stand included fittings for industrial, commercial and resi-

Ltd.; Crompton Parkinson, Ltd.; Ekco-Ensign Electric Ltd.; Hailwood and Ackroyd, Ltd.; Oswald Hollmann, Ltd.; I.C.I. Ltd.; Longlamps, Ltd.; Joseph Lucas, Ltd.; Oldham and Son, Ltd.; Harry J. Pratt and Co., Ltd.; "Triplex" Safety Glass, Co., Ltd.; Walsall Conduits, Ltd.; Wardle Engineering Co., Ltd.

Street Lighting in Northern Ireland

Lisburn's £28,000 street lighting scheme is the most comprehensive yet carried out with fluorescent tubes in the United Kingdom and the only one of its kind in Northern Ireland.

One hundred and seventy Siemens Wilton-Sieray 3-80 lanterns have been installed for Class "A" lighting on main thoroughfares, each lantern containing three 80-watt 5-ft. fluorescent tubes. These lanterns are mounted on Concrete Utilities, Ltd., 3 DN standards, 25 ft. high, incorporating a special fluorescent lantern head. On other roads nearly 400 Wilton-Sieray 2-40 lanterns are used, each lantern containing two 40-watt fluorescent tubes, mounted on 15-ft. concrete standards.

The scheme was carried out by the Electricity Board for Northern Ireland. The whole installation is controlled by "Rhythmic" ripple control equipment manufactured and installed by Automatic Telephone and Electric Company, Ltd., Liverpool. "Rhythmic" is a method of injecting pre-selected signals of voice frequency current which traverse the entire a.c. distribution network. These signals are dis-

tinct and are filtered from the normal current supply.

Entire control is from the Castle-street sub-station, which serves a total of 32 sub-stations in the area. The signals are received by sensitive tuned relays which control automatic switches mounted on the various lamp standards.

The equipment at Castle-street sub-station provides for eight different signals, of which three are used for street lighting. One is a common "on" signal for all lamps. There are two "off" signals, one for those lamps which are to be switched off at midnight and one for those which are to be switched off at dawn. Other signals may be used subsequently for such facilities as water heating, load shedding, and for control of shop window lighting, etc. The signals are initiated from a control panel fitted with automatic time-controlled selector switches. Provision is also made for manual control.

Showing the fluorescent lighting in Railway Street, Lisburn.



Problems in Illuminating Engineering For Students

By S. S. BEGGS, M.A., F.I.E.S.

10. Exterior Lighting Installations

Although the basic principles of good lighting apply to exterior as well as to interior lighting installations, the importance of the various factors is usually different, and economic considerations play a major role in the determination of what is practical. In general, because of the larger areas, high illumination levels are prohibitive in cost; fortunately for most exterior activities at night lower values are adequate, if not ideal. For many purposes, however, ordinary lighting methods fail, and recourse has then to be made to a different technique, such as in street-lighting, or to the use of the lights as guides or signals, as is common for air, sea and land traffic purposes. Street-lighting is a special and important field, which will be considered in the next article; here we shall consider other forms of exterior lighting. These may be divided into three main categories, viz.: (1) general illumination of an area; (2) artistic lighting, and (3) guiding lights. Examples of the first are area lighting for commercial and industrial purposes (e.g., car parks, railway yards, docks or quarries) and sports lighting (e.g., courts, greens, baths or race tracks); the second includes decorative, spectacular and advertisement lighting (e.g., floodlighting of buildings and gardens, hoardings and signs), and the third, traffic control and guidance by lights, of which an important new field is airport and airway lighting.

For the first category, the rules enunciated for interior lighting apply generally. The spacing-height ratio and diversity of illumination will usually be greater than that regarded as satisfactory for interior lighting, and more attention must be paid to the light distribution from the individual fitting. The lumen-method may be used to calculate the total flux required, the type, number and location of the lights being determined by practical considerations. The areas illuminated by successive lights must overlap sufficiently to keep the diversity of illumination within the desired limit.

In the second category the illumination required depends on the brightness of the surroundings and the reflection characteristics of the object to be lighted; the flux required can be calculated by the lumen method, as for industrial floodlighting. However, the artistic effect is of quite as much importance as the illumination level, and the proper use of light and shade is very important to obtain a good result.

In the third category, where the area is much too large for adequate illumination, the lights are viewed directly, and the main considerations are their pattern, colour and intensity distribution, and the effect of varying atmospheric conditions on their visibility.

Every application cannot be studied in detail, but the general considerations applicable to exterior lighting, and the requirements and limitations of individual important lighting fields should be known.

Question 18 (1945)

A church seen in plan has the form of a cross. Above the intersection of the two parts of the cross rises a tower to a height of 150 ft. above the roof. The base of the tower is 100 ft. square and the four parts of the church, which form the limbs of the cross when seen in plan, have each the same width as the tower. Three of these limbs are 100 ft. long and the fourth 200 ft. long.

Design a scheme for floodlighting the tower from the roof of the church, and give a brief specification of the type of floodlight required.

Answer

(1) DESIGN OF FLOODLIGHTING SCHEME.

The floodlighting of the tower only will be considered, but in practice it is undesirable to light only parts of a building, and disrupt its character as a complete entity.

To determine the amount of light required, the general brightness of the surroundings and the approximate reflection factor of the building surface must be known. As the tower will usually be seen against the night sky, and, generally, neighbouring buildings are not likely to be brightly lighted, medium

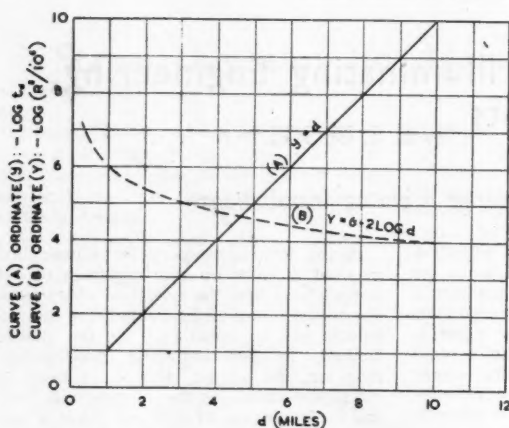


Fig. 7. Graphs for determination of transmission and range of a lighthouse beam.

to low surround brightness will be assumed. The church will probably be of stone, and even if light in colour originally will darken with age and accumulation of dirt. The reflection factor is likely to be fairly low, say about 20 per cent. For these conditions an illumination between 5 and 10 lm./sq. ft. should be provided.

The tower is to be lighted from the roof of the church; the beam throw is long. Narrow- or medium-angle projectors will be required, which will have an average beam factor of 0.4. As the tower face is a large rectangle, the waste light factor will not be high, say about 1.2. Finally, the fittings will be fairly accessible for cleaning, and unless in an industrial area are not likely to get very dirty. A depreciation factor of 1.5 will therefore be taken as applicable. The total light flux F required to illuminate one face to an average value of 8 lm./sq. ft. is then given by

$$F = \frac{8 \times 150 \times 100 \times 1.2 \times 1.5}{0.4} = 5.4 \times 10^5 \text{ lumens.}$$

For a church, highly coloured light is not desirable, although plain mercury or sodium vapour lamps might be permissible. However, tungsten filament lamps are preferable, and almost essential for the narrow-angle beams required. If 1,000-watt lamps are used of about 18,000 lumens output, the number required is

$$(5.4 \times 10^5 / 1.8 \times 10^4), \text{ i.e., } 30.$$

The projectors can be mounted well away from the tower face—say at 80 to 100 ft. distance—and the elevation varies from 0 deg. to about 60 deg. A narrow-beam type of floodlight has a beam-spread of 25 to 30

deg. with a general service lamp, and about half this spread with a projector type. At the offset considered, the former would cover an area about 50 ft. in diameter on the lower part of the tower, and the latter an area about 40 ft. wide and 60 ft. high when directed towards the upper part (elevation about 50 deg.). The tower surface may therefore be divided roughly into rectangles 25 ft. high and 20 ft. wide, and a floodlight directed towards the centre of each rectangle; those illuminating the lower half should be equipped with general service type (angle burning) lamps, and those for the upper half with lamps of projector type.

The illumination will decrease towards the top of the tower, but not noticeably to the eye. As it presumably will be seen from all sides, all four faces of the tower should be lighted. The exact position of the floodlights must depend on the architecture of the roof on which they are mounted, but they must be arranged to avoid a flat, "stage scenery" appearance by the judicious use of shadows. Those lighting the upper parts should be farther from the tower base than those lighting the lower part, so that the shadows cast by architectural forms are generally similar. The beams should also be directed obliquely in plan, to give natural light and shade on vertical features, such as window reveals. For example, it might be possible to mount the six projectors lighting any one of the five vertical bands of 20 ft. width in line with the centre of the adjacent band. The lamp light outside the beam will ensure that the shadows are not too heavy. A further effective method for

giving three-dimensional form to the tower is to reduce the illumination on two opposite faces, preferably the N. and S., so that the change in the plane of the face is accentuated; the ratio of the illuminations may be as much as 10 to 1.

(ii) SPECIFICATION OF FLOODLIGHT.

The floodlight required must be of narrow-angle type and designed for high-wattage general service and projector-type lamps. The specification would be as follows:—

- Reflector— Deep parabolic form, of silvered glass with copper and lead backing.
- Front glass— Clear, domed, heat-resisting glass.
- Housing— Spun copper, weather-proof, with wrought-iron cradle, allowing rotation and elevation of beam up to 60 deg.
- Lamp— Arranged to take 1,000-watt angle-burning, general service and projector-type lamps, with focusing adjustment.

Question 19 (1948)

Plot a graph showing the atmospheric transmission at distances between one mile and ten miles for a transmission of 10 per cent. per mile. With the aid of this graph determine the distance at which a lighthouse of 1,000,000 candles would be seen in such conditions.

Answer

(i) GRAPH RELATING TRANSMISSION AND DISTANCE.

If the transmission per mile is t , the transmission t_d over a distance of d miles is t_d ; hence

$$\log t_d = d \cdot \log t.$$

The relation between the logarithm of the transmission and distance is therefore linear. For the given atmosphere

$\log t_1 = -1$ and $\log t_{10} = -10$, and the graph relating $-\log t_d$ and d is the line (A) shown in Fig. 7.

(ii) RANGE OF LIGHTHOUSE.

The threshold of visibility of a "point" source is affected by many factors, such as the state of adaptation of the eye or the comfort of the observer, but for given conditions it appears to be determined by the illumination of the retina. The maximum distance at which such a light will be picked up with reliability under normal practical

conditions is usually taken to be that at which the illumination at the eye of the observer is 1' mile-candle.

The illumination E in mile-candles provided by the lighthouse of 1,000,000 candle-power at distance d miles under the stated conditions is given by:—

$$E = (10^6 \times t_d) / d^2.$$

The maximum range, R miles, of the light is therefore such that

$$1 = (10^6 \times t_r) / R^2,$$

$$\text{or } \log t_r = \log (R^2 / 10^6) = 2 \log R - 6.$$

By plotting the graph of $(6 - 2 \log d)$ against d on the same sheet as the previous graph (curve (B) of Fig. 7), the value of R (determined by the point of intersection of the two curves) is found to be 4.67.

Thus, the lighthouse would be visible in the specified atmospheric conditions at distances up to approximately four and two-thirds miles.

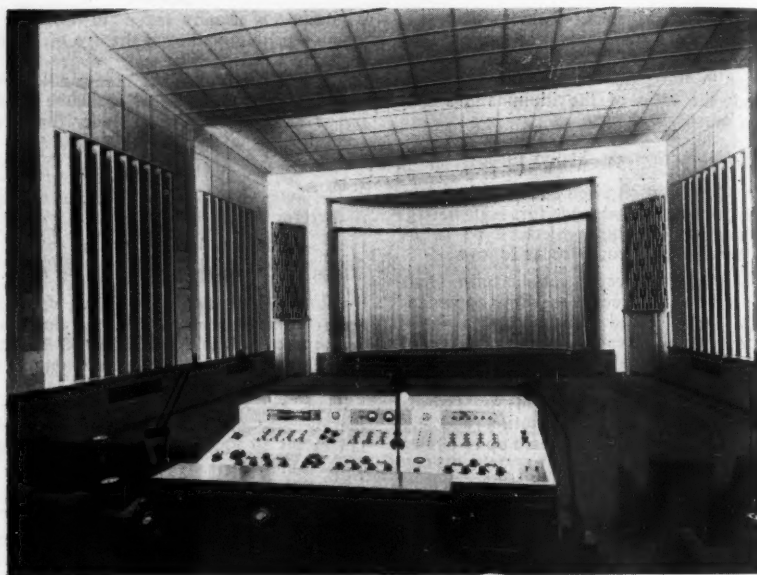
A.P.L.E. Conference Bournemouth

The Annual Conference of the Association of Public Lighting Engineers is to be held at Bournemouth from September 18-23. Following the official opening of the Conference, the Mayor of Bournemouth will open an exhibition of street lighting apparatus and equipment where lanterns, control and switch gear, etc., will be displayed. There will also be an outside demonstration of lamp columns, tower wagons and ladders.

It is understood that the subjects of papers to be presented include the forthcoming code of practice on street lighting, the amenity value of street lighting, road safety, and the use of acrylic materials.

16th International Congress of Ophthalmology, July 17-22, Lighting Exhibition

This exhibition, which has been organised by the I.E.S., will be held at the London School of Hygiene, Kepple-street, W.C.2. It will remain open during the week commencing July 24 between the hours of 10.30 a.m. and 6 p.m. for the benefit of members of the I.E.S. who may wish to visit it.



Lighting at a Film Studio

The manifold activities involved in film production call for varied types of lighting technique to be applied on the studio premises. Office, workshop and canteen lighting are needed on the same scale as in a large factory, and may follow similar principles, but the projection theatres where the films are screened during and on the completion of production require special treatment. There are three such theatres at the Elstree Studios, Boreham Wood, of the Associated British Picture Corporation, Ltd., where all the lighting equipment for the new buildings has been supplied by the General Electric Co., Ltd.

In the Dubbing and Preview theatres the auditorium lighting is provided by warm white cold cathode tubing concealed in special lighting coves, which span the roof and extend down each wall nearly to floor level. Both installations are controlled by motor-driven dimmers, and the effect at full illumination is a soft, diffused light of a rest-

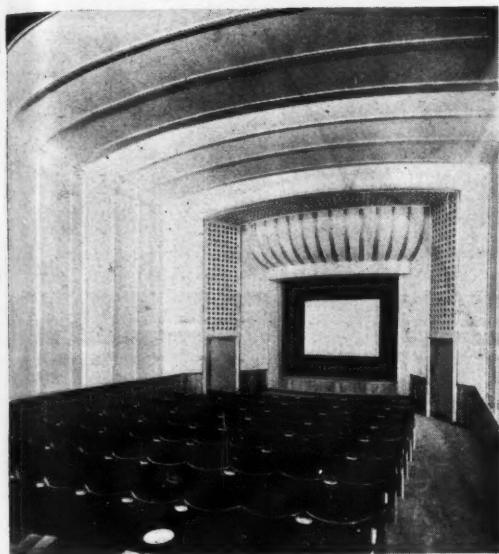
Parts of Elstree Film Studios have recently been modernised, and new lighting has been installed in the projection theatres, offices, workshops, and canteen.

ful quality. The ends of the tubes containing the electrodes are turned back so that their lighting lengths are continuous.

It is in the Dubbing Theatre that the final sound track of the film is prepared by electronic mixing of the separate dialogue and effects tracks. This operation is regulated from a control desk at the back of the hall, which can be floodlit by means of four Georay reflectors. The general lighting comes from a double run of cold cathode tubes in each of the four lighting coves, totalling 712 ft. of tubing.

The Preview Theatre is lighted on similar

(Above). The Dubbing Theatre, lighted by concealed cold cathode tubes.



(Above) Showing the cold cathode lighting in the Preview Theatre.

lines with concealed cold cathode tubing, but with a single run in each of the four coves, 396 ft. of tube in all.

The Scoring Theatre is used for recording music and is a spacious, soundproof building with acoustic walls and ceiling, large enough to accommodate a full orchestra. Individual vocalists can record in separate cubicles. A high level of illumination is provided in the theatre by three rows of special reflector fittings, each with four runs of cold cathode tube, totalling 618 ft. Films can be screened in the theatre to assist in the synchronising of background music, and dimming is therefore provided for the cold cathode lighting.

In all three theatres the transformers are above the ceilings, and special measures have been taken to ensure that no hum reaches the auditorium.

Other cold cathode installa-

tions have been made in the cafeteria and restaurant used by the studio staff and artistes. The cafeteria fittings are six standard three-tube units, each with two intermediate tubes and one gold. In the restaurant 14 decorative fittings are used, the design consisting of two pairs of concentric circles of tubing springing from a central drum which contains the gear. The drum is closed on the under side by a decorative spinning with finial. Intermediate and gold tubes are used together here as in the cafeteria, this combination, in conjunction with the decorative scheme of the rooms being found to permit a high level of illumination that at the same time has a warm and

(Below) The Scoring Theatre where orchestral music is recorded.



Showing decorative cold cathode lighting in the Studio Restaurant.



pleasing quality suitable for the moments of off-duty relaxation enjoyed in this part of the premises.

The offices in the administrative block are lit by Osram hot cathode fluorescent lamps, using decorative fittings in some parts of the building. The four fittings in the general manager's office take two 4-ft. lamps each behind a reeded "Perspex" enclosure and have real bronze colour end pieces. Six single-lamp fittings of similar design are used to light the conference room.

A very large number of standard G.E.C. fittings of various types is involved in the

complete hot cathode fluorescent lighting scheme covering all the offices and corridors of the administrative block and the workshops and other premises where the numerous services ancillary to film production are carried on.

Joint architects on the modernisation of the studio were Mr. William R. Glen, F.R.I.A.S., L.R.I.B.A., and Mr. C. J. Foster, L.R.I.B.A., Mr. C. A. Every being electrical consultant co-operating with the joint architects. The electrical contractors were Barlow and Young, Ltd., 16, Palace-street, Westminster, S.W.1.

Correspondence

To the Editor of LIGHT AND LIGHTING.

Sir,—With reference to the remarks on "Quantity and Quality," under Notes and News, in the March, 1950, issue, I have tried to give below a detailed explanation of "quality." It is, indeed, a very complex and subtle effect of illumination; at the same time I believe it is much more important than quantity since we now have relatively high levels of illumination.

"Quality" and "quantity" are too much alike in spelling and sound to make good descriptive words. I much prefer your "suitability" for quality or, better yet, why not use "Light" for quantity and "Lighting" for quality to get "Light and Lighting"?

I must admit that "quality of illumination" was not entirely comprehended until

I tried to describe the term. Perhaps I have left out some portion of it others may detect. At any rate, with your assistance and with the help of contributors we may be able to tie this term down securely.—Yours, etc.,

GEORGE P. WAKEFIELD.

Vermilion, Ohio.

WHAT IS QUALITY OF ILLUMINATION?

It is diffusion, the absence of shadows, as illustrated by a sunless day outdoors. Such illumination prevents the formation of shadows by providing light completely around an object. This characteristic is ideal for drafting rooms.

It may be the opposite, the shadow-forming power of the source such as the sun outdoors. When the seeing task demands the help of a shadow this feature is important. A three-

dimensional task represents a shadow-requiring seeing problem.

It is the colour of the source, yellow sodium or white fluorescent. For colour matching a north sky white may be required. For the living room a relatively yellow incandescent lamp adds hominess and warmth.

It is the direction of the flux in relation to the task. Light coming over the left shoulder provides a suitable direction to ensure the reflected light from coming back to the eyes. Seeing tasks on glossy surfaces, this includes most paper, are especially benefited by directional control.

It is the brightness of the source in the reflected glare zone, usually from directly under the source to about 45 deg. High brightness provides annoying reflections from shining surfaces and diminishes visibility of the task. Low brightness sources minimize this shortcoming. Paper tasks of all sorts are easier as this zonal brightness diminishes.

It is the brightness of the luminaire (sometimes the ceiling or walls) in the direct glare zone 45 deg. to horizontal. A bright luminaire or ceiling will cause distracting glare as the eyes roam around a room.

It is the ratio of brightness throughout a room. Abnormally bright and dark ceilings illustrate this characteristic. Sharp contrasts are to be avoided. A ratio of 1 to 10 between the task and adjacent surroundings would seem ideal.

In short, quality of illumination consists of the factors, excluding the amount of light, that promote efficient seeing.

The Editor of LIGHT AND LIGHTING.

Sir,—In your May issue you have opened your correspondence columns to two more self-styled morons, so perhaps you will allow me a short "come-back." As to "Halfwit's" solution of the nomenclature problem, I could not agree with him more. Of course we should adopt "lux" (though not just because it is the best word for the job), but we won't! As long as I can remember—and before—adoption of the metric system in this country has been advocated. But, not in my time, nor in "Halfwit's," will this be done; though if this prediction is falsified, no one will be better pleased than I. Meanwhile,

Where snappy "lux" is contraband,
And lacks its "fiat" in this land,

Let apt and willing "lura" stand.

Only one fear besets me concerning the adoption of "lux"; it is that the poor lighting salesman may tire of explaining to the domestic user that it is *not* the stuff for washing "woollies."—Yours, etc.,

DIMMERWIT.

London.

I.E.S. Summer Meeting

(Continued from p. 220)

presented the Dow Golf Cup, which is played for at the Summer Meetings of the Society, and which, on this occasion, was won by Mr. A. D. S. Atkinson, of London.

The president then proposed a vote of thanks to all those who had taken part in the organisation of the meeting, including the authors of the papers, the chairmen of the technical sessions, the North Western Electricity Board, who had arranged the necessary electricity supplies and had arranged for the floodlighting in Buxton during the course of the meeting, Mr. P. Corry and his helpers who had been responsible for the excellent stage arrangements at all meetings, and to the projectionists, and to Messrs. Elsie Battle, Ltd., for having kindly arranged the mannequin parade. The President then thanked the Summer Meeting committee and the papers committee for all their work, and he also thanked the Secretary and staff at the Society headquarters. Sincere appreciation was expressed to the Mayor of Buxton, Councillor G. A. Williams, and to the town of Buxton for their hospitality to the Society, and to Mr. J. A. Robinson, publicity manager for Buxton.

Mr. H. C. Weston then proposed a vote of thanks to Dr. J. N. Aldington.

In reply, Dr. Aldington said that, as the occasion was the last on which he would appear at such a representative gathering of members, he would like to express his appreciation of the kind way in which he and Mrs. Aldington had been received during his year of office. He had been very touched by the kindness and consideration that had always been shown to him, and he wished to publicly express his thanks to everyone.

During the course of the Summer Meeting a number of buildings in Buxton were floodlighted under arrangements made by the North Western Electricity Board. The buildings illuminated included St. John's Church, the Spa Hotel, the Palace Hotel, the Crescent, the dome of the Devonshire Hospital, and the Town Hall. The firms in the industry who co-operated with the North Western Electricity Board included the Wardle Engineering Co., Ltd., the G.E.C., Ltd., Siemens Electric Lamps and Supplies, Ltd., the B.T.H. Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd. The borough council were responsible for the lighting of the Town Hall and gardens.

REVIEWS OF BOOKS

"Recent Advances in the Physiology of Vision," by Hamilton Hartridge, M.A., M.D., M.R.C.P., ScD., F.R.S. Director, Vision Research Unit (M.R.C.). J. and A. Churchill, Ltd., London. Price 25s.

Studies of vision specifically directed to practical lighting problems are not allotted much space in Professor Hartridge's book—for example, the earlier work on disability glare and more recent investigations on discomfort glare are not mentioned. Nevertheless the account given of some of the new results and current views on the way the eye works should be of interest to most lighting engineers. The main subjects discussed are the resolving power of the eye and the several factors—chromatic and spherical aberrations, eye motions, retinal astigmatism, etc.—which may affect it, the perception of colour including the properties of colour defectives, the electrical response of the retina as measured on experimental animals, the photo-sensitive and other coloured pigments in the eye, the course and connections of the nerve fibres from the rods and cones of the retina to the brain, and the various theories of vision, in particular theories of colour vision. In addition, short sections are devoted to such topics as vision in polarised light and the luminous appearances produced by subjecting the eye to electric and magnetic fields.

Professor Hartridge is a noted controversialist, and he has included expositions of some views which are highly tentative. Like many others he is dissatisfied with the trichromatic theory, but he has gone further than most in postulating additional receptors and anti-chromatic mechanisms. In the section dealing with his polychromatic theory, like a skilful juggler, he keeps seven receptor systems in the air with great virtuosity. His critics might say that his receptor systems are altogether too much in the air, and it must be admitted that very little quantitative evidence on their properties is advanced. This gives the author of the theory a good deal of latitude. We learn, for example, that two of the receptors are in some way linked as complementaries to two of the others, in the manner of Hering's theory. One is tempted to recall a stanza of Wordsworth:—

"How many are you, then," said I,

"If they two are in heaven?"

Quick was the little maid's reply,

"O Master, we are seven."

If it is the research worker on vision who will get most out of Professor Hartridge's book, to others interested in the subject who like their science free of mathematics and not too much encumbered with professional

jargon, this new volume of a renowned series of Churchill publications may be heartily recommended.
W. S. S.

"Colours and How We See Them," by H. Hartridge, M.A., M.D., ScD., F.R.S., Director of the Vision Research Unit of the Medical Research Council and Professor of Physic at Gresham College, London. G. Bell and Sons, Ltd., 1949, price 15s., with 39 text figures and 12 plates in colour.

This fascinating book contains the substance of the Royal Institution Christmas lectures given by the author in 1946. Beginning with a description of the properties of the spectrum, the author goes on to describe how colours are produced, what uses they have, and how we see them. The last two of the six chapters are devoted to some illusions of colour and to some colour curiosities. The actual lectures were accompanied by many demonstrations; all of them interesting and some ingenious and beautiful. These demonstrations are described with the aid of diagrammatic drawings of the apparatus used and of the method of setting it up. Nearly seventy points with which the author deals are effectively illustrated in a series of twelve coloured plates; these illustrations are a striking and valuable feature of the book and undoubtedly they will prove most instructive to the general reader, for whom they have been particularly designed.

The book is packed with interesting information presented concisely and in very readable style. Since the lectures on which the book is based were not intended for advanced students, the author's own researches on colour vision are naturally treated more briefly than in some other of his writings. Occasionally, this brevity cuts explanations too short. For example, according to section 65, the yellow and blue retinal image fringes produced by chromatic aberration in the eye are eliminated by a mechanism between the retina and the brain. This is said to change yellow to pale grey or white, and blue to dark grey or black, but the ordinary reader may wonder why this mechanism does not make him yellow and blue blind. To the old question, why do things not look upside down to us—although they are imaged this way on our retinæ—the author replies that it is because the brain is upside down in respect to the environment. Actually, the distinction of up and down, as well as of right and left, does not depend on the orientation of the brain but on our correlation of sensations of touch and movement with those of sight.

The pleasures of sight are so enormously enhanced by colours that the subject of Professor Hartridge's book is of interest to all but the rare individuals whose vision is monochromatic.



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New Lighting Installations

Bank Building Lighting in Singapore

The new head office of the Hong Kong and Shanghai Banking Corporation operating in Malaya, is one of the largest of the building constructions undertaken since the fall of Singapore to the Japanese.

It is also one of the few completely air-conditioned buildings in Malaya. The lighting of the main banking hall and four of the office floors, together with the manager's flat on the top floor, has been carried out by the Singapore branch of the General Electric Co., Ltd.

The banking hall is lighted by both hot and cold cathode fluorescent tubing in ceiling-mounted units and by light-well skylights adapted as laylights. These skylights offered a particular problem, since the four trough reflectors suspended above the glazing had to be placed in such a manner that their shadow was not thrown on the glass by the daylight entering through the roof of the skylight. Each fitting accommodates two 4-ft. 40-watt hot cathode lamps. Positioned around each of these laylights are locally made six-tube adaptations of the standard G.E.C. three-tube cold cathode fittings, formed by two fittings mounted side

by side with a common electrode box at each end. Each combined fitting contains two Warm White and four Intermediate cold cathode tubes. The hot cathode lamps employed in the laylights are daylight colour.

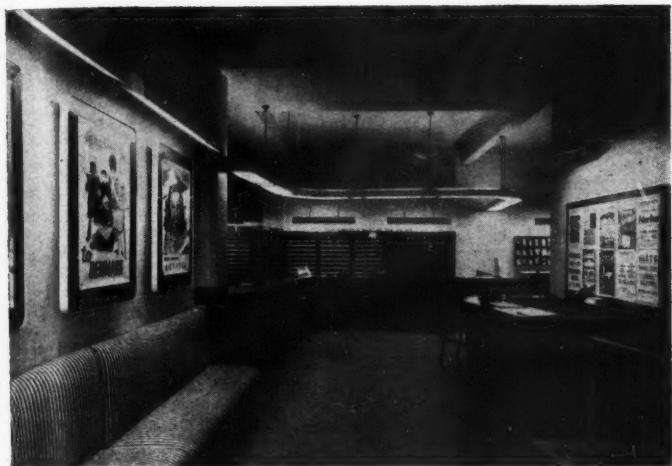
The lighting for the public area of the hall is carried out by means of three pure laylights, in each of which are mounted 10 Osram 5-ft. 80-watt daylight tubes, whilst mounted on the ceiling around the laylights are five standard G.E.C. three-tube cold cathode fittings to blend with the locally adapted six-tube fitting, each with one Warm White and two Intermediate tubes.

The combination of laylights and other fittings provides very even illumination over the whole area of the banking hall. The average intensity over the working area is approximately 20 lumens per sq. ft., whilst that of the public area is approximately 12 lumens per sq. ft. The total lighting load in the hall, including gear losses, is about 6,410-watts.

On four of the office floors the lighting is by Osram 5-ft. 80-watt lamps in G.E.C. "Seagull" channel style fittings, of which there are 480 in all, whilst the manager's flat above has been treated with tungsten decorative fittings with emphasis on indirect lighting.



Fluorescent lighting in the banking hall of the head office of the Hong Kong and Shanghai Banking Corporation.



Showing the interesting lighting installation at the Workers' Travel Association, London.

Lighting in Travel Bureaux

The picture above shows the travel office at the W.T.A. headquarters, in Gillingham-street, London. The lighting fitting, which follows the curve of the counter, was specially designed by Messrs. Hugh Roberts and Davies, and incorporates 5-ft. daylight fluorescent tubes and 150-watt tungsten lamps alternately. This combination gives a softer effect than the use of fluorescent tubes alone. The underside of the fitting is 6 ft. from the counter, where the level of illumination is approximately 30 lumens per

sq. ft. Messrs. Troughton and Young, Ltd., supplied the fittings.

The Swedish Travel Bureau, the interior of which is illustrated below, was designed by Messrs. Gerald Lacoste and Kenneth Dod. Except for daylight fluorescent lighting in the windows the installation consists of 100-watt silvered tungsten lamps. The lamps are housed in fibrous plaster fittings, the circular dishing design of which is repeated as ceiling decoration. Dome-shaped castings of arctic glass are provided to soften the effect of the lighting. The level of illumination on the counter is 9 lumens per sq. ft.

Lighting at the Swedish Travel Bureau in Leicester Sq.





The Berkhamsted Town Hall, Hertfordshire, was recently re-lighted. The main hall is now equipped with 16 5ft. "Perspex" fluorescent fittings, giving a general illumination of 10 lumens persq.ft. The installation was carried out by the Eastern Electricity Board.

Interior Lighting at the Mansion House

The re-lighting of the Egyptian Hall of the Mansion House was carried out under the supervision of the City Surveyor to the Corporation of London.

The Main Hall has concealed fittings on the cornice at the springing of the barrel vaulted ceiling.

Thirty-two special cornice fittings were designed and manufactured by Messrs. Courtney, Pope (Electrical), Ltd., These were installed along both sides of the existing cornice in continuous rows.

One hundred and twenty-eight "Warm White" lamps were supplied by Messrs. Thorn Electrical Industries, Ltd.

Below the gallery 152 fluorescent lamps are used in the existing coves.

The hall is 82 ft. long, 50 ft. wide, and an average illumination of six lumens per square foot is obtained at floor level.

The entire installation was carried out by Messrs. Girdlestone and Co., Ltd., under the main contractors, Messrs. Holliday and Greenwood, Ltd.



Fluorescent lighting in the re-conditioned Egyptian Hall.

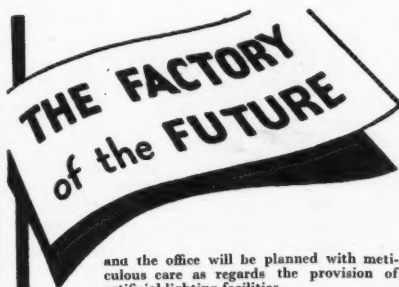


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POSTSCRIPT

As well as by the excellent presentation of the papers at the recent I.E.S. Summer Meeting in Buxton, I was well impressed by the quality of the ensuing discussions. Most of the contributors made their points well, and most of them spoke in a lively and apparently extemporaneous manner, so holding my attention more successfully than the few who read their contributions. It was a wise decision of the Organising Committee to allow more time for discussion than was available at the previous summer meeting in Harrogate.

We need to be careful in drawing conclusions from the evidence of our eyes, for things are not always what they look to be, and much light may reveal little to us. These are the truths of which Dr. Sayce's address on Visual Deception so entertainingly reminded me when I heard it at Buxton. Visual deception being one of the functions of theatre stage lighting, Mr. Applebee's paper on the last day of the Buxton meeting may be said to have continued the story begun by Dr. Sayce on the first day. Seeing amiss can be very dangerous, but we can hardly reproach ourselves for our illusions of sight when these are induced by the protective devices with which some living creatures are endowed, or by the skilful artifice or "low cunning" of man: indeed, it is to such illusions that we owe not a few of our pleasures.

But, what of our many failures to see "adequately" illuminated things spread out before our open eyes? A learned Judge was recently reported as saying—apropos a witness's uncertainty about some feature of a sight familiar to him—"If I were asked the colour of the carpet in the drawing-room of a house in which I have lived for sixty years I should not know." This is not a case of colour blindness, and the carpet in question must have been imaged on the Judge's retinae many hundreds of times. Similar instances of failure to "develop" large numbers of ocular "photographs" are within the experience of everyone: they remind us that what we really mean by "seeing" involves a mental process, so that we are not bound to see what is "staring us in the face" just because it is well-lighted

By "Lumeritas"

and we have sound eyes. Should we reproach ourselves for these failures to see? Certainly yes for some of them but by no means for all. Sometimes, not seeing (i.e., "overlooking" or not "noticing") what is openly displayed to our view has unfortunate or even disastrous consequences. Nevertheless, besides being of no interest or use to us, it would be quite impossible (and certainly disconcerting) to see with the mind everything the eyes behold. We are not exclusively visual creatures (nor "seeing machines"!), but must needs ignore some visual stimuli if the mind is to have time to hear, feel, taste, and so on. Which things we see and which we generally "overlook" depends greatly on our individual interests—economic and otherwise, but when there is no interest in seeing certain things we may sometimes succeed in making them seen by means of suitable lighting. In this matter pedagogues have something to learn from stage and display lighting experts.

Unfortunately, lighting engineers sometimes succeed in making us see what we don't want to see and what it is not to our advantage that we should see—namely, light sources? I have in mind a much-lauded new street lighting installation (le dernier cri) which, as a display of lamps, is an arresting sight, though it would have been much better and more to the purpose if it compelled me to see the road. I do not mean that the road surface is not well illuminated but, for me at any rate, the lamps themselves "steal" the sight.

Writing of unwanted sights reminds me of an unexpected instance reported in the daily Press at the end of last month. It appears that the coloured borders of the envelopes used for air mail letters are trying to the eyes of sorters and postmen, so that the Postmaster-General is prohibiting the use of these envelopes. The "Daily Telegraph" is startled by the official explanation that the "embarrassing" colour is red, since this is "our Post Office's own chosen hue." Certainly this explanation seems unconvincing, but then there are reds and reds, and the air mail letter red is not the pillar-box and postal-van red, to which postal workers are inured!

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